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TOP 10 **HUBBLE IMAGES**

APRIL 2015

# NATIONAL GEOGRAPHIC

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Images of the “Pillars of Creation” are among thousands the Hubble Space Telescope has captured. In this issue lead Hubble imaging scientist Zoltan Levay picks his ten favorites.

PHOTO: NASA; ESA; HUBBLE HERITAGE TEAM, STSCI/AURA. COLORIZED COMPOSITE/MOSAIC

Are your favorite Hubble photos in our gallery of top shots? Go to [ngm.com/more](http://ngm.com/more).

## 62 Hubble's Greatest Hits

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*Story and Photographs by Marco Vernaschi*

**On the Cover** Alexander Gardner photographed Abraham Lincoln on November 8, 1863, 11 days before the president delivered the Gettysburg Address. *Photograph from Library of Congress*

**Corrections and Clarifications** Go to [ngm.com/more](http://ngm.com/more).

## The Longing for Lincoln

Doris Kearns Goodwin, the best-selling chronicler of America's presidents, knows the question historians would expect her to ask Abraham Lincoln if she could. How would you have dealt with Reconstruction differently than Andrew Johnson? the dutiful Goodwin would inquire. Lincoln's death cut

short what probably would have been a gentler approach to the South after the Civil War, she explains. If he'd lived, "it might have helped ease the racial tension that's lasted for hundreds of years."

But given the chance to actually sit down with our 16th and, arguably, greatest president, Goodwin would ask something very different. "I would just say to him, Tell me a story," she says. "The minute he started telling a story, his eyes would light up, as if he had just come from black and white into full color."

April 14 marks the 150th anniversary of Lincoln's assassination. Like Goodwin, many of us seek that essential Lincoln. We want to understand how a boy who knew so much privation and loss became a man of resilience, confidence, and humility, whose spirit still helps define the nation he loved and saved.

This is the story that writer Adam Goodheart and photographer Eugene Richards set out to tell as they retraced the path of Lincoln's funeral train over 1,654 miles, from Washington, D.C., to its final stop in Springfield, Illinois. Perhaps a million people filed past the president's open coffin; millions more lined the tracks. It was an outpouring of shared grief after a war that killed as many as 850,000 American soldiers.

What was this longing for Lincoln, and why does it endure?

On one level, says Goodwin, it's obvious. "He won the war, saved the Union, ended slavery. That legacy is a permanent legacy to our nation and an advance of social justice." But she also thinks that Lincoln's life story itself touches emotions in a singularly powerful way.

She quotes from Ernest Hemingway's *Farewell to Arms*: "The world breaks every one and afterward many are strong at the broken places."

"This is true of Lincoln," Goodwin says. "He had a sustaining spirit."



This portrait of a contemplative Lincoln was made on August 9, 1863, in a Washington, D.C., photo studio.

Susan Goldberg, Editor in Chief



A man with dark hair and a beard is looking down at a bunch of green bell peppers he is holding in his hands. In the foreground, there is a glass bowl filled with a green salad. To the left of the bowl is a glass of water. The background is a blurred outdoor scene with greenery and a blue sky. Two overlapping blue circles are positioned between the man and the salad.

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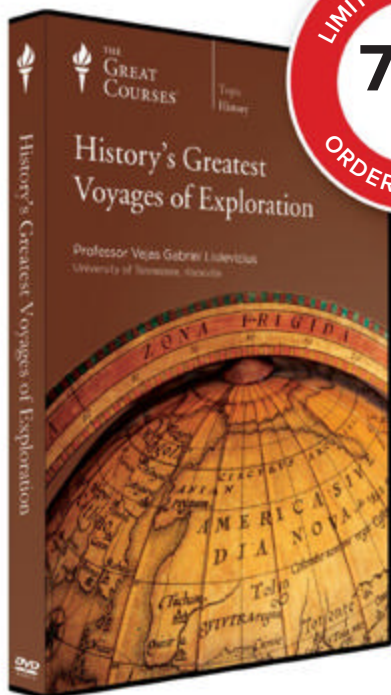
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### 3 Questions

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## Why I'm a Man of Science—and Faith

**Francis S. Collins**, a physician and the geneticist behind the Human Genome Project, is the director of the National Institutes of Health. He is also founder of the BioLogos Foundation ([biologos.org](http://biologos.org)), a group that fosters discussions about the intersection of Christianity and science.

### Are science and religion compatible?

I am privileged to be somebody who tries to understand nature using the tools of science. But it is also clear that there are some really important questions that science cannot really answer, such as: Why is there something instead of nothing? Why are we here? In those domains I have found that faith provides a better path to answers. I find it oddly anachronistic that in today's culture there seems to be a widespread presumption that scientific and spiritual views are incompatible.

### When people think of those views as incompatible, what is lost?


Science and faith can actually be mutually enriching and complementary once their proper domains are understood and respected. Extreme cartoons representing antagonistic perspectives on either end of the spectrum are often the ones that get attention, but most people live somewhere in the middle.

### You've said that a blooming flower is not a miracle since we know how that happens. As a geneticist, you've studied human life at a fundamental level. Is there a miracle woven in there somewhere?

Oh, yes. At the most fundamental level, it's a miracle that there's a universe at all. It's a miracle that it has order, fine-tuning that allows the possibility of complexity, and laws that follow precise mathematical formulas. Contemplating this, an open-minded observer is almost forced to conclude that there must be a "mind" behind all this. To me, that qualifies as a miracle, a profound truth that lies outside of scientific explanation.

PHOTO: REBECCA HALE, NGM STAFF





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Bravecto is for dogs 6 months of age or older. Side effects may include vomiting, decreased appetite, diarrhea, lethargy, excessive thirst, and flatulence.

Please see Brief Summary of Prescribing Information on following page.





**BRIEF SUMMARY (For full Prescribing Information, see package insert)**

**Caution:**  
Federal (USA) law restricts this drug to use by or on the order of a licensed veterinarian.

**Indications:**  
Bravecto kills adult fleas and is indicated for the treatment and prevention of flea infestations (*Ctenocephalides felis*) and the treatment and control of tick infestations [*Ixodes scapularis* (black-legged tick), *Dermacentor variabilis* (American dog tick), and *Rhipicephalus sanguineus* (brown dog tick)] for 12 weeks in dogs and puppies 6 months of age and older, and weighing 4.4 pounds or greater.

Bravecto is also indicated for the treatment and control of *Amblyomma americanum* (lone star tick) infestations for 8 weeks in dogs and puppies 6 months of age and older, and weighing 4.4 pounds or greater.

**Contraindications:**  
There are no known contraindications for the use of the product.

**Warnings:**  
Not for human use. Keep this and all drugs out of the reach of children. Keep the product in the original packaging until use, in order to prevent children from getting direct access to the product. Do not eat, drink or smoke while handling the product. Wash hands thoroughly with soap and water immediately after use of the product.

**Precautions:**  
Bravecto has not been shown to be effective for 12-weeks duration in puppies less than 6 months of age. Bravecto is not effective against *Amblyomma americanum* ticks beyond 8 weeks after dosing.

**Adverse Reactions:**  
In a well-controlled U.S. field study, which included 294 dogs (224 dogs were administered Bravecto every 12 weeks and 70 dogs were administered an oral active control every 4 weeks and were provided with a tick collar); there were no serious adverse reactions. All potential adverse reactions were recorded in dogs treated with Bravecto over a 182-day period and in dogs treated with the active control over an 84-day period. The most frequently reported adverse reaction in dogs in the Bravecto and active control groups was vomiting.

**Percentage of Dogs with Adverse Reactions in the Field Study**

Adverse Reaction (AR)	Bravecto Group: Percentage of Dogs with the AR During the 182-Day Study (n=224 dogs)	Active Control Group: Percentage of Dogs with the AR During the 84-Day Study (n=70 dogs)
Vomiting	7.1	14.3
Decreased Appetite	6.7	0.0
Diarrhea	4.9	2.9
Lethargy	5.4	7.1
Polydipsia	1.8	4.3
Flatulence	1.3	0.0

In a well-controlled laboratory dose confirmation study, one dog developed edema and hyperemia of the upper lips within one hour of receiving Bravecto. The edema improved progressively through the day and had resolved without medical intervention by the next morning.

For technical assistance or to report a suspected adverse drug reaction, contact Merck Animal Health at 1-800-224-5318. Additional information can be found at [www.bravecto.com](http://www.bravecto.com). For additional information about adverse drug experience reporting for animal drugs, contact FDA at 1-888-FDA-VETS or online at <http://www.fda.gov/AnimalVeterinary/SafetyHealth>.

**How Supplied:**  
Bravecto is available in five strengths (112.5, 250, 500, 1000, and 1400 mg fluralaner per chew). Each chew is packaged individually into aluminum foil blister packs sealed with a peelable paper backed foil lid stock. Product may be packaged in 1, 2, or 4 chews per package.

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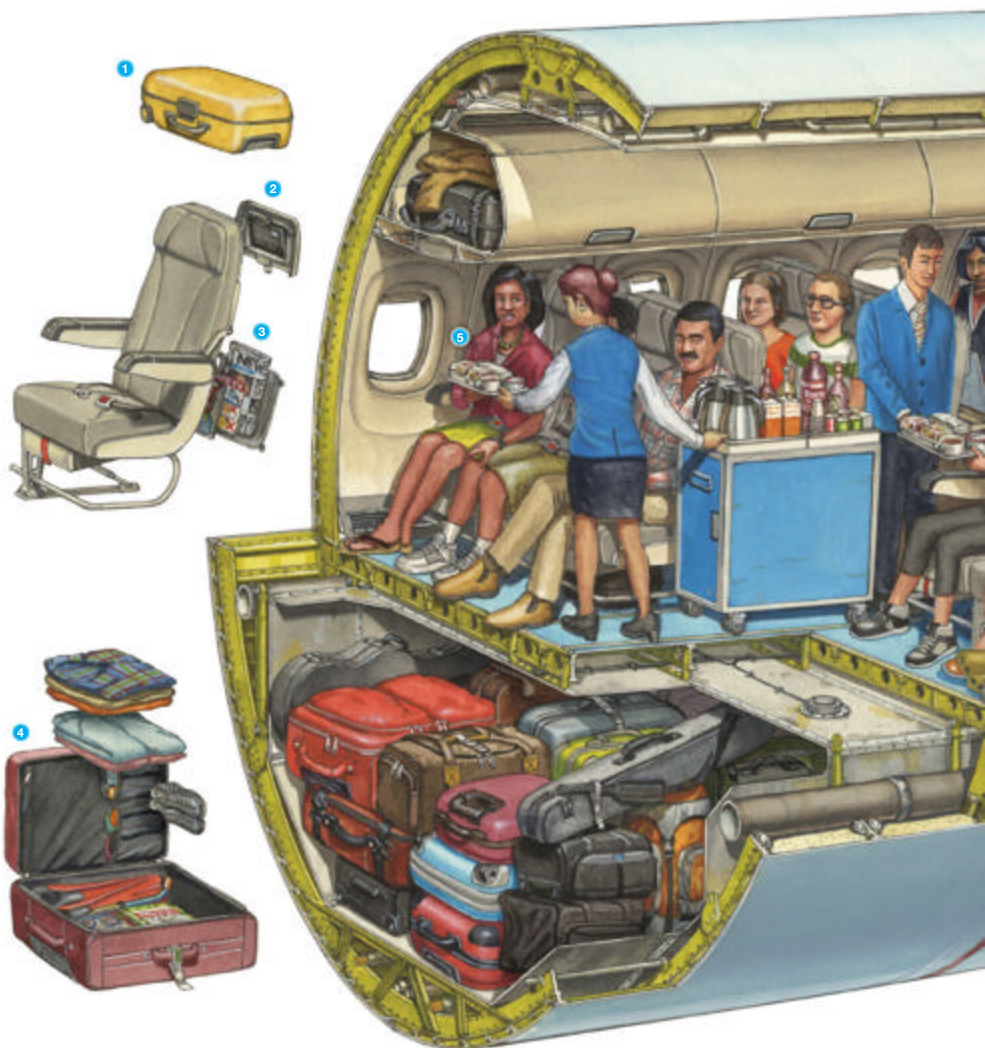
# EXPLORE



## Light Flights

While airlines may set the fares and fees for air travel, the decisions made by passengers also come with costs. Every item on board makes a plane heavier, which burns more fuel. An airliner's cost of operating rises with every laptop (70 cents per flight), pillow (12 cents), or magazine (11 cents) you bring along.

Want your flight to burn less fuel? Start by emptying your bladder before boarding. MIT aeronautical engineers Luke Jensen and Brian Yutko used a set of typical U.S. and European flight conditions to analyze how specific items add up on three major carriers (United, American, and Ryanair) over a normal day. Uncertainties abound, such as the price of fuel or the cost of an unexpected detour. And even if passengers help reduce weight, airlines don't always share savings with ticket buyers. But the surest way to minimize the cost of flying a plane, says Jensen, is to limit the number of things—like bags—that people can bring aboard without an extra fee. —Daniel Stone







### WHAT IT COSTS

Your ticket accounts for you—and the items you carry. During one year on a Boeing 737-800 operated by United, even small things add up to big costs.

*Added fuel cost for one item on one plane over one year*

1 Carry-on \$980 15 lbs	2 Video console \$457 7.0 lbs	3 Magazine \$46 0.7 lbs	4 Suitcase \$3,267 50 lbs	5 Meal tray \$65 1.0 lbs	6 Neck pillow \$42 0.65 lbs
7 Full bladder \$29 0.44 lbs	8 Laptop \$291 4.46 lbs	9 Tablet \$59 0.9 lbs	10 Cell phone \$25 0.38 lbs	11 12-oz. drink \$56 0.86 lbs	12 Peanut packet \$2 0.03 lbs

### WHERE PLANES GO

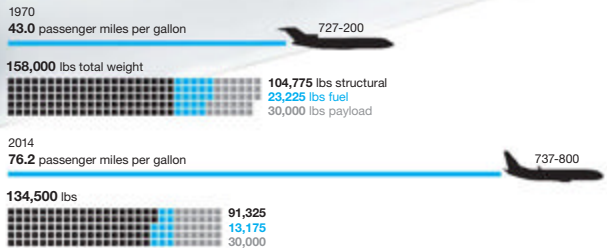
To make an aircraft cost-effective, airlines need to constantly move people or things. In one day a typical Boeing 737 flies about 4,300 miles.

	Fuel weight (lbs)	Fuel volume (gallons)
1. EWR Newark, NJ		
to 2. IAH Houston, TX.....	19,000	2,800
to 3. PDX Portland, OR.....	23,000	3,400
to 4. SFO San Francisco, CA.....	10,000	1,400
to 5. RDU Raleigh-Durham, NC.....	29,000	4,400
	<b>12,000 Total</b>	



### HOW FAR WE'VE COME

Compared to 40 years ago, today's single-aisle jets can carry the same size load the same distance on roughly half the fuel. Lighter hulls, more fuel-efficient engines, and improved aerodynamics allow airlines to maximize the number of passengers.



Cost calculations were made using Boeing 737-800 aircraft carrying 75 percent of payload capacity. Passenger miles per gallon is derived from a plane's average miles per gallon multiplied by the typical number of passengers.

MATTHEW TWOMBLY, NGM STAFF. ART: HANS JENSSEN. SOURCES: BRIAN YUTKO AND LUKE JENSEN

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Michelle Atkinson,  
CMO, Energizer,  
on the New *Energizer®*  
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# NOVATION

## Q&A



What provided the inspiration for **Energizer® EcoAdvanced™**?

A:  
→

"The moment of inspiration happened on a visit to a recycling plant," said Michelle Atkinson, Energizer's Chief Marketing Officer. "Everyone said making a battery with recycled battery material couldn't be done, but our scientists wouldn't take no for an answer. They discovered a way to refine and transform recycled material - true closed loop innovation - to make our longest-lasting alkaline battery. At the same time, consumers told Energizer that they wanted more than just long-lasting batteries. They wanted batteries that were reliable and responsible as well - so we knew we were onto something. Energizer® EcoAdvanced™ is another world's first from the brand that delivers a high performance battery made with recycled batteries - 4 percent today by weight, with a vision for more in the future."

How long was the battery in development?

A:  
→

Energizer® invested seven years and more than \$20 million in development to bring Energizer® EcoAdvanced™ to life. "This is the first step in creating value for recycled battery material - which until today had little use or economic value," said Atkinson. This value enables the industry to expand processing capacity, which today is the bottleneck to increasing the use of this technology more broadly.

How much testing goes into the release of a new product?

A:  
→

"With a new product, there is both ongoing consumer testing and product testing," said Atkinson. "As for the product, it starts with evaluating a range of raw materials and identifying the ones that best meet our specifications. Then samples are made with those raw materials and tested before moving to full-scale production. Visual and quantitative testing occurs at every stage of the production process. The final product is tested to ensure that it performs well in a variety of device and consumer-usage situations. We continually test our products for performance, quality, reliability and safety to ensure the consumer receives the best experience possible. From a consumer perspective, Energizer's goal is to uncover the unmet or unarticulated need and then work with our award-winning scientists to deliver on those needs better than anyone else."

What makes this battery longer-lasting and more responsible than Energizer's standard alkaline battery?

A:  
→

Energizer® EcoAdvanced™ is the brand's longest-lasting alkaline battery, and it provides consumers with responsible power. Energizer® EcoAdvanced™ also has less impact on the planet because it contains a portion of material from recycled batteries, thus, less virgin material is required in the manufacturing process. And by using longer-lasting batteries, consumers use fewer batteries and create less waste.

What impacts does it have for future?

A:  
→

We will continue to innovate and reduce the impact Energizer® batteries have on the planet. By 2025, our vision for Energizer® EcoAdvanced™ is to increase the amount of recycled battery material ten-fold to 40 percent. And, in the future we envision all Energizer® batteries being made with some recycled battery material.



EXPLORE  
**Planet Earth**

## ***Splash Down***

More than one million swimming pools gleam from California's backyards. With the state in its fourth year of drought, these residential oases have become a target of local water restrictions. Yet pools can waste less water than traditional lawns, research has shown.

"The big thing with a pool is that you fill it once," says Jonathan Volzke, spokesperson for the Santa Margarita Water District in Orange County, which rolled back its pool prohibitions after analyzing water usage. Pools are also usually surrounded by decks, which means an area up to three times the size of the pool no longer requires any water at all. Add a cover to prevent evaporation, and a pool can use even less water over time than drought-tolerant landscaping. —*Rachel Hartigan Shea*

PHOTO: DAMION BERGER

# This Is How To Walk the Walk

*The must-have men's accessory once carried by kings, presidents, barons and billionaires is back—and can be yours for **ONLY \$49!***

They call walking the “perfect exercise.” It gets your heart pumping, clears your head and fills your lungs with fresh air. Not bad, but we found a way to make it even better. Before you take your next 10,000 steps, add a little strut to your stroll. Take the **Stauer Gentleman's Walking Stick** anywhere and I promise that you'll feel like a conquering hero. Heads will turn. Doors will open. Its powers will astound you.

What's the secret? Pure class. Our **Stauer Gentleman's Walking Stick** is a tip of the top hat to turn-of-the-century tradition. Today, serious collectors gladly pay thousands for rare and handcrafted sticks from the 19th century. But only Stauer can deliver a modern version of this vintage classic—that looks and feels as good as the original—for **ONLY \$49!**

**Sticks that make a statement.** For centuries, no respectable man was seen in public without a walking stick by his side. They were as indispensable as a fine tailored suit or fancy moustache. Well-heeled men “wore” them as symbols of power and prestige, using elaborately decorated staffs to help navigate trails, dispatch opponents or conceal gadgets and contraband. Simply put, they were the must-have accessory for any sharp-dressed man on the move.

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actual size.







A hunter felled this giraffe in Eastern Cape, South Africa, in 2012.

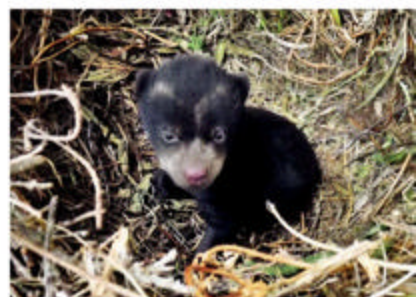
## *Giraffes at Risk*

With their striking coat patterns and towering height, giraffes are iconic African creatures—yet they haven’t been the subject of much scientific study. Now re-searchers who track the animals report a disturbing trend: Across the continent populations have dwindled from 140,000 to fewer than 80,000 over the past 15 years, according to the Giraffe Conservation Foundation (GCF).

Slow-moving and enormous, “giraffes offer an easy target and lots of meat” for poachers, particularly in the war-torn Democratic Republic of the Congo, says GCF Executive Director Julian Fennessy. Herds also are diminished by habitat loss and by hunters who cater to the superstition among some tribes that eating giraffe brains wards off HIV. Still, says Fennessy, there is hope for the future. “We wouldn’t be doing this work if we thought it was too late.” —*Catherine Zuckerman*

### **CUB PROVIDES HOPE FOR THREATENED SPECIES**

In summer 2014, while tracking a rare Andean bear in Ecuador’s Cayambe Coca National Park, scientists noticed that her activity centered on one area—a possible sign of nesting. They later found her cub. The animals, known also as spectacled bears for their facial markings, belong to the only wild bear species in South America; by some estimates, fewer than 3,000 now live in Ecuador. Ongoing observations of this cub will shape efforts to save the solitary, vulnerable species and perhaps boost its numbers. —*Lindsay N. Smith*





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EXPLORE

## Planet Earth: By the Numbers

# Climate and Birds

Climate change is threatening some of North America's most beloved birds. According to a recent Audubon Society report, by 2080 shifting temperatures could greatly reduce the habitats of ten U.S. state birds.

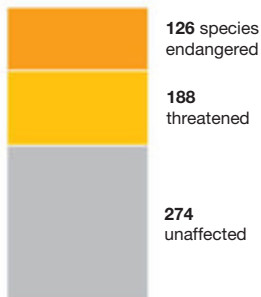
Since bird populations are indicators of ecosystem health, it's important to track their numbers to determine where conservation efforts are needed most. Bird-watchers are helping by uploading as many as eight million bird sightings every month to eBird, an online database with nearly 250 million records. Mark Reynolds of the Nature Conservancy says crowdsourcing is one tool for saving fleeting habitats. —Kelsey Nowakowski

## DECLINING HABITATS

NUMBER OF BIRD SPECIES AT RISK OF LOSING HALF THEIR HABITAT BY 2080

# 314

Climate change could affect more than half the 588 species in the Audubon report.



## CONSERVING HABITATS IN CALIFORNIA

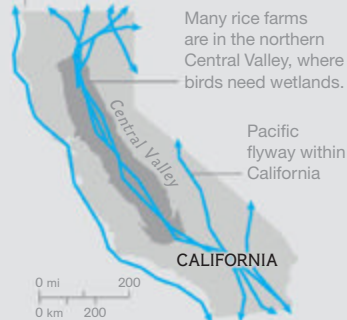
Millions of birds forage in wetlands while migrating along the route known as the Pacific flyway. Wetlands, once abundant in California, have decreased, cultivated by farmers or drained by the ongoing drought.

# 1 billion

birds migrate along the Pacific flyway each year.

Many breed in the high Arctic in summer; some fly as far as the tip of South America to winter.

### CENTRAL VALLEY WETLANDS



## BIRD POPULATION CHANGE BY HABITAT

Percentage change 1968-2012  
Percentage change 1968-2012





More than 350 bird species use the Pacific flyway each year.

## RENTING FARMS FOR TEMPORARY HABITAT

A new Nature Conservancy program pays rice farmers in the northern Central Valley to flood their fields during peak migration times. These “pop-up” habitats are cheaper than setting aside and maintaining permanent refuges.



1. **MINE THE DATA**  
Crowdsourced data on bird sightings and NASA satellite images are analyzed to determine where and when wetlands are most needed.



2. **RENT THE FIELDS**  
Flooding rice fields in late winter can be risky: They might not dry out by planting time. Farmers are compensated accordingly.



3. **FLOOD THE FIELDS**  
Fields are covered with a few inches of water for two to eight weeks. Migrating birds feed and rest in the pop-up habitats.



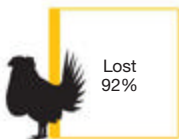
4. **SAVE THE BIRDS**  
The temporary wetlands hosted more than 50 species of shorebirds, waders, and waterfowl—200,000 birds—in 2014.

9,600

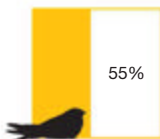
acres of pop-up habitat were flooded in 2014.

## HABITAT LOSS BY 2080

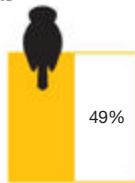
Modeling suggests that the species below will lose a significant amount of habitat. Conservation efforts have expanded habitats of winter-coastal and wetland species such as mallards.



Greater sage-grouse  
Arid land



Whip-poor-will  
Eastern forest



Northern pygmy owl  
Western forest



Sprague's pipit  
Grassland



Pacific golden plover  
Ocean, coast



## A Mural's New Date

Surreal life-size figures on a sandstone wall in Utah's Horseshoe Canyon may be thousands of years younger than experts estimated. Using new techniques to gauge how long rocks had been exposed to sunlight, researchers significantly narrowed the period in which the mural must have been painted.

Their reconstruction of events: 2,000 years ago a sheet of rock fell from the cliff. Artists then used the fresh surface as their canvas. About 900 years ago another sheet fell, taking a few painted figures with it.

Steven Simms, a Utah State University archaeologist involved in the research, thinks the paintings may have been made within a few hundred years of the first rockfall, during a time of major transformation as corn farmers from the south moved into a region peopled by hunter-gatherers.

In Simms's scenario "the farmers come in large numbers. They take over the land, hunt all the game. The hunter-gatherers are pushed to the margins." Under those circumstances, he says, "this art could be something of an old tradition that they're holding on to for power purposes." —A. R. Williams

### REPATRIATING HISTORY

After two centuries abroad, Mexico's first sweeping, native-authored history is back home again. Last fall the National Institute of Anthropology and History acquired three 17th-century volumes—two written in Spanish; the third, the *Codex Chimalpahin* (below left), in Nahuatl—from the British and Foreign Bible Society. In 1827 a priest traded the vivid, hand-written accounts of life, society, and politics in Aztec Mexico for a stack of Bibles. Now that the tomes have returned to Mexico, historians there can get a fresh look at their country's pre-Hispanic past. —Jeremy Berlin





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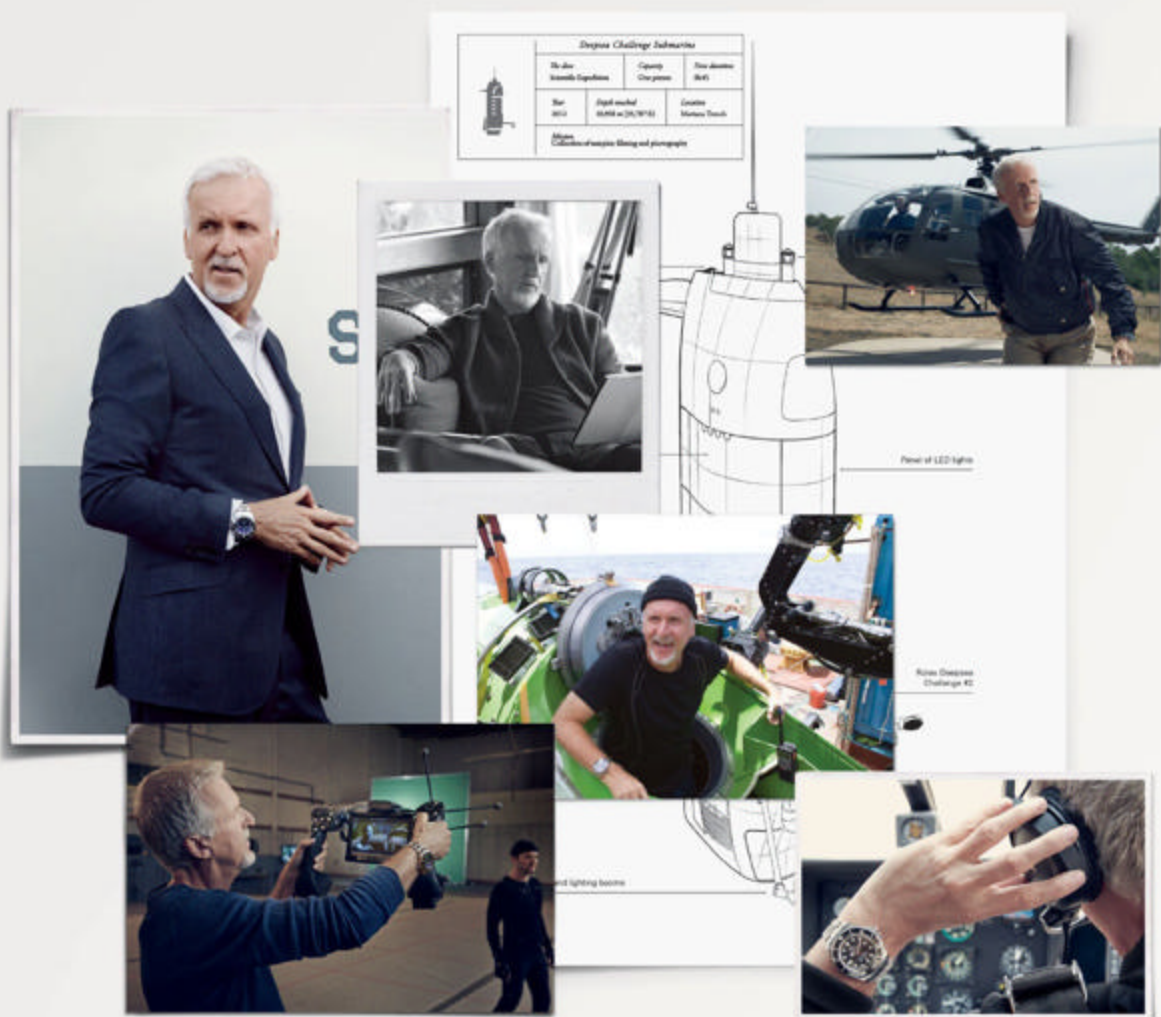
## ***The Dawn of Impressionism***

At 7:35 a.m. on November 13, 1872, in the port city of Le Havre, France, the art world changed forever. Claude Monet gazed out his hotel window and began to paint what he saw. The result (above) was “*Impression, Soleil Levant*” (“*Impression, Sunrise*”)—and the birth of a movement.

How do we know exactly when Impressionism began? Because of Donald Olson, a Texas State University astrophysicist who uses astronomy to solve art and literary mysteries. When art historian G rardine Lefebvre and Marmottan Monet Museum deputy director Marianne Mathieu asked Olson to help determine the painting’s provenance, the self-styled “celestial sleuth” began by poring over maps and photos to identify Monet’s hotel and room. Then he turned to astronomy—using the rising sun and the moon to determine the tide, season, and time of day—and consulted digitized 19th-century weather observations. The final clues were the smoke plumes in the painting, showing the wind blowing east to west.

Those findings—plus the “72” by Monet’s signature—closed the case and put a precise time stamp on a timeless work of art. —*Jeremy Berlin*





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### MUSTARD MUSEUM

There is a National Mustard Museum in Middleton, Wisconsin.



### FEED THE TEEN

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Us

# Pointing the Way

St. George, Utah



Flying was still in its intrepid, barnstorming days in the mid-1920s when the U.S. Department of Commerce began establishing airways, prescribed routes in the sky, to promote air commerce. How did pilots navigate their way cross-country in planes—some of them left over from World War I—that had only rudimentary instruments? Often by peering down from the cockpit to look for the big concrete arrows pointing the way.

It may have been either a slightly crazy or brilliantly simple scheme, or both. More than a thousand concrete arrows were installed along the federal airway system, says Phil Edwards, a technical information specialist at the Smithsonian National Air and Space Museum Library. Up to 70 feet long and painted yellow or other highly visible colors, arrows were placed 10 to 15 miles apart and at night were illuminated by beacons. Pilots flying at low altitudes, typically under 3,000 feet, could see from one to the next.

Metal arrows also were installed on some routes—but by the 1940s, the system was largely superseded by radio aids to navigation. Today history buffs have preserved or restored a few beacon sites, including one in Cibola County in western New Mexico. Many abandoned arrows are overgrown or crumbling. But dozens—like the one shown here—survive, especially in remote areas along the transcontinental airway that ran from New York to San Francisco. They remain to befuddle hikers and others who stumble upon them, mysterious remnants of a more romantic era of flight. —Reed Karaim



Before pilots had radio navigation aids to guide them along U.S. air routes, they found their way by looking for the beacons and the concrete and metal arrows that marked many of the routes.



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**What does the Settlement provide?** If the Settlement is approved and becomes final, Class Members who submit a claim proving that they are the original purchaser of a Washer will receive a \$55 payment from the Settlement (unless they previously received a full refund or free exchange of a Washer) and will release all claims against Bosch and Siemens (see also "What are my rights?" below).

**How can I get a payment?** File a claim online at [www.BoschSiemensWashingMachinesClassAction.com](http://www.BoschSiemensWashingMachinesClassAction.com) by **May 28, 2015** or call 1-877-695-7474.

**Who represents me?** The Court has appointed Eppsteiner & Florica Attorneys, LLP as Lead Counsel to represent the Class in this case. You do not have to pay Class Counsel or anyone else to participate. You may hire your own lawyer to represent you at your expense.

**What are my rights?** You have a choice of whether to stay in the Class or not. If you submit a claim, file an objection or do nothing, you are choosing to stay in the Class, and you will be bound by the Court's decisions and the Parties' Final Settlement Agreement and Release. Any claims you may have against Bosch and Siemens relating to the Washers will be released and you will be forever barred from asserting these claims against them. If you want to keep your right to sue the Defendant yourself, you must exclude yourself from the Settlement Class by **April 30, 2015**. If you exclude yourself, you cannot get a payment from this Settlement. To ask to be excluded from the Class, send a letter to Bosch Siemens Washing Machines Class Action Administrator, PO Box 43340, Providence, RI 02940-3340, postmarked by **April 30, 2015**, stating you want to be excluded from *Cobb v. BSH Home Appliances Corp.*, Case No. 8:10-cv-00711. Include your name, address, telephone number, and signature. If you stay in the Settlement Class, you may object to the Settlement by **April 30, 2015**. Visit [www.BoschSiemensWashingMachinesClassAction.com](http://www.BoschSiemensWashingMachinesClassAction.com) for details about how to object.

The Court will hold a hearing on June 1, 2015 to consider whether to approve the Settlement, a request for attorneys' fees and expenses of up to \$6.5 million and a \$5,000 payment to each of the four Class Representatives. You or your own lawyer may appear at the hearing at your own expense.

**1-877-695-7474**

**[www.BoschSiemensWashingMachinesClassAction.com](http://www.BoschSiemensWashingMachinesClassAction.com)**



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✓Yes



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## Basic Instincts

A genteel disquisition on love and lust in the animal kingdom

### RANGE

Mexico, southwestern U.S.

### CONSERVATION STATUS

Least concern

### OTHER FACTS

Gray-banded king snakes (seen here) as well as rat, corn, and garter snakes belong to the superfamily Colubroidea. Boas and anacondas belong to the family Boidae.

## Snakes' Charming Moves

Drawing his chin along her skin. Coiling his body about hers. Jerking his head seductively, biting her, and vibrating his tail. In the Kama Sutra of snake sex, these are prime mating moves among colubroids, the world's largest family grouping of snakes with some 2,500 species.

To see how snake courtship evolved, herpetologist and paleontologist Phil Senter studied data on 76 snakes of the Colubroidea and Boidae groups. From research that included studies of fossil records dating to the Cretaceous period, he found that some colubroid come-ons are ancient—chin-rubbing, jerking—while the “coital bite” and “tail quiver” began later. In all, he says, it’s “quite the set of dance moves.”

The snake-atop-snake courtship position called mounting is “nearly universal” in the species studied, Senter wrote in the journal *PLOS ONE*. However, he noted with clinical delicacy, mounting is not required for “intromission,” aka copulation. To mate, snakes need only to align the base of their tails at the cloaca, an opening serving both reproductive and excretory systems. The male extends his hemipenes, the two-pronged sex organ stored in his tail, and with each half deposits sperm into the female’s cloaca. The sex act can last for hours, Senter says—commonly, longer than the courtship. —Patricia Edmonds

Photos of the gray-banded king snake (*Lampropeltis alterna*) were shot at Texas' Fort Worth Zoo.

PHOTOS: JOEL SARTORE





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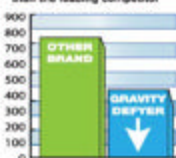
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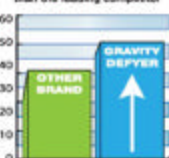
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# VISIONS

A wide-angle photograph of a lush green field filled with numerous yellow dandelions and some purple wildflowers. In the background, a dense line of green trees separates the field from a clear blue sky. A tall, thin radio tower is visible in the distance, rising above the trees. The foreground shows a dirt path and a single dandelion seed head in sharp focus.

## United States

In Baltimore's Druid Hill Park, a dog named Phoebe faces off with a dandelion. To make this shot, the photographer held the flowering weed at arm's length, several feet from Phoebe's face, and used his camera flash to make the seed head glow.

PHOTO: MICHAEL NORTHRUP









# Iceland

Wearing masks of silica mud at the Blue Lagoon Spa, playful Japanese pensioners pretend to be zombies. These warm geothermal waters—100°F to 102°F and rich in minerals—are said to soothe psoriasis and other skin afflictions of the living.

PHOTO: CORNELIU CAZACU





A woman is shown from the chest up, wearing a large, wide-brimmed hat with a colorful, abstract pattern in shades of pink, purple, blue, and yellow. She is holding a black smartphone in her right hand, which displays a close-up photo of Kim Kardashian smiling. The woman has long blonde hair and is wearing a red top. The background is blurred, suggesting an outdoor setting.

### United States

At the 140th Kentucky Derby in Louisville, Sophie Gillotti displays her Kim Kardashian cell phone case. The celebrity wasn't in attendance this year, but the 164,906 people who were saw California Chrome carry the day at Churchill Downs.

PHOTO: LONDON NORDEMAN

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## Unexpected Discoveries

**Assignment** We asked members of the Your Shot community to turn their cameras into witnesses, capturing moments neither anticipated nor planned.



### EDITOR'S NOTE

“Serendipity doesn’t happen by accident. It comes when you put yourself into situations where you know there will be photographs and are open to whatever unfolds.”

—Randy Olson, National Geographic photographer



**Christina Leow Wan Hui**  
Singapore

Leow was surprised to see zebras in Nairobi’s Jomo Kenyatta International Airport. While she waited for a flight, she marveled at the large animal decals that covered the windows—then raised her camera. “It was a reaction to a very creative display,” she says.

**Andrea Giacomini**  
Los Angeles, California

During a typically dry summer in southern California, Giacomini went to pick up a friend. As he idled, he noticed Griffith Park behind him was on fire. It looked, he says, like an apocalyptic scene.



# LIN



Life mask of Abraham Lincoln done two months before his death


In early 1865, Abraham Lincoln consented to having another life mask made of him, this time by sculptor Clark Mills. This process began with an application of all over Lincoln's face, followed by a life cast of plaster powder. After fifteen minutes, Mills asked Lincoln to remove his hair, and the plaster took off in large pieces after a while. Mills then recommended the process to have the forehead mask.

A comparison between Mills' mask shows the Lincoln's health. One month after this mask was made, Lincoln died.

Clark Mills (1840-1900) Plaster life mask, c. 1865




# COLN



On the 150th  
anniversary  
of the Great  
Emancipator's  
assassination,  
Americans along  
the route of  
his funeral train  
reflect on his life  
and legacy.

Children in Washington, D.C., view a plaster cast of a life mask of  
Lincoln's face, made nine weeks before his death in April 1865.

AT NATIONAL PORTRAIT GALLERY, SMITHSONIAN INSTITUTION



Thousands of New York commuters, like these in Harlem, travel daily on sections of Lincoln's funeral route, which ran more than 1,500 miles from Washington, D.C., to Lincoln's hometown of Springfield, Illinois.

*We here highly resolve that...government of  
shall not perish from the earth.*






*the people, by the people, for the people,*

—Abraham Lincoln, Gettysburg Address, November 19, 1863







A photograph of the interior of Ford's Theatre, showing a red tufted sofa, a mirror, and a lamp. The room has red patterned wallpaper and a large mirror. A lamp is mounted on the wall. An American flag is visible on the left.

*Let us have faith that  
right makes might, and  
in that faith, let us, to  
the end, dare to do our  
duty as we understand it.*

*—Abraham Lincoln, Cooper Union Address, February 27, 1860*

The site of the president's assassination has been restored at Ford's Theatre. This view is approximately the same one that John Wilkes Booth had just before firing his weapon, a single-shot derringer pistol.



By Adam Goodheart

Photographs by Eugene Richards

T

he black box nestles deep beneath the U.S. Capitol, encased behind thick glass, caged by a metal grille, as if it were a dangerous object, a ticking bomb primed for its inevitable explosion. Perhaps in a sense it is. In April 1865 carpenters constructed this velvet-draped bier, known as the Lincoln catafalque, to display the

murdered president's casket in the building's Rotunda; its dark cloth conceals the rough pine boards they hastily nailed together. Since then, it has been brought out each time a national martyr or hero lies in state: James Garfield, William McKinley, John F. Kennedy, Douglas MacArthur. The rest of the time it sits in a niche of the Capitol Visitor Center, passed without a glance by most of the tourist throngs as it awaits the next great American death.

Abraham Lincoln's assassination, 150 years ago this month, has been recounted and reenacted innumerable times: The fateful trip to the theater, the pistol shot in the presidential box, the actor-assassin's melodramatic leap to the stage, and death's arrival at last in the back room

of a cheap boardinghouse. Much less known is the story of what followed. The nation mourned Lincoln as it had never mourned before. In the process, it not only defined the legacy of an American hero, it also established a new ritual of American citizenship: the shared moment of national tragedy, when a restless Republic's busy life falls silent.

During the weeks after Lincoln's death, as his funeral train made a circuitous journey from Washington, D.C., back to his hometown of Springfield, Illinois, perhaps a million Americans filed past the open coffin to glimpse their fallen leader's face. Millions more—as much as one-third of the North's population—watched the procession pass.

That history isn't so very far away: A 70-something friend of mine recalls hearing his grandfather talk about seeing the funeral cortege as a young boy in New York City. And even today,

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*Adam Goodheart is the author of 1861: The Civil War Awakening. Eugene Richards photographed "The New Oil Landscape" in the March 2013 issue.*



Lincoln was the first person to lie in state on the U.S. Capitol's catafalque. Since then, 36 Americans have been honored on it, including three other assassinated presidents.

as I recently discovered, to follow the route of Lincoln's train is to discover how much his spirit still pervades the nation he loved and saved.

On the first day of Lincoln's last journey, April 19, the line of soldiers, officials, and citizens following the hearse from the White House to the Capitol stretched well over a mile—"the grandest procession ever seen on this continent," a reporter called it. During the days before the murder, the city—and half the country—had been celebrating the Confederate surrender at Appomattox. Now the same flags hung to hail victory were shrouded in black crepe.

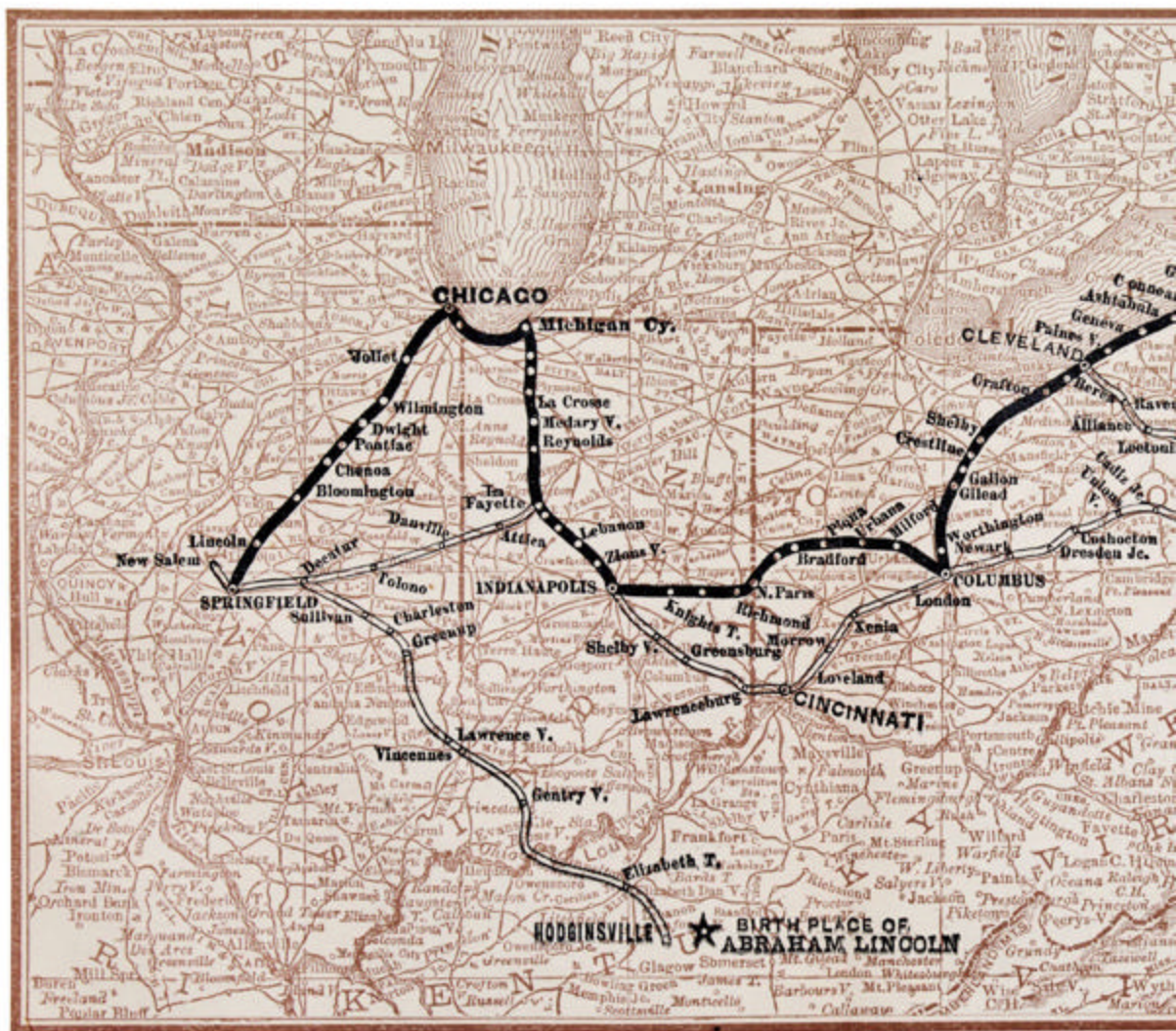
Two days later, under drizzly skies, a nine-car train pulled out of Washington's main railway station. It was headed north, yet just a few minutes into its journey it crossed into what had very recently been slave territory.

From Freeland to New Freedom, the old train tracks rise gently out of Maryland toward the Pennsylvania hills. One of these auspiciously named hamlets sits just south of the Mason-Dixon Line separating the two states, the other just north. Until Maryland enacted emancipation just five months before Lincoln's death, this line was like an electrified fence standing



**A HISTORIC JOURNEY** A map published in an 1889 biography of Lincoln outlines the circuitous journey to his final resting place in Springfield, Illinois. Much of the route retraced Lincoln's path to the capital for his 1861 inauguration.

REBECCA HALE, NGM STAFF, AT AMERICAN UNIVERSITY LIBRARY, WASHINGTON, D.C.



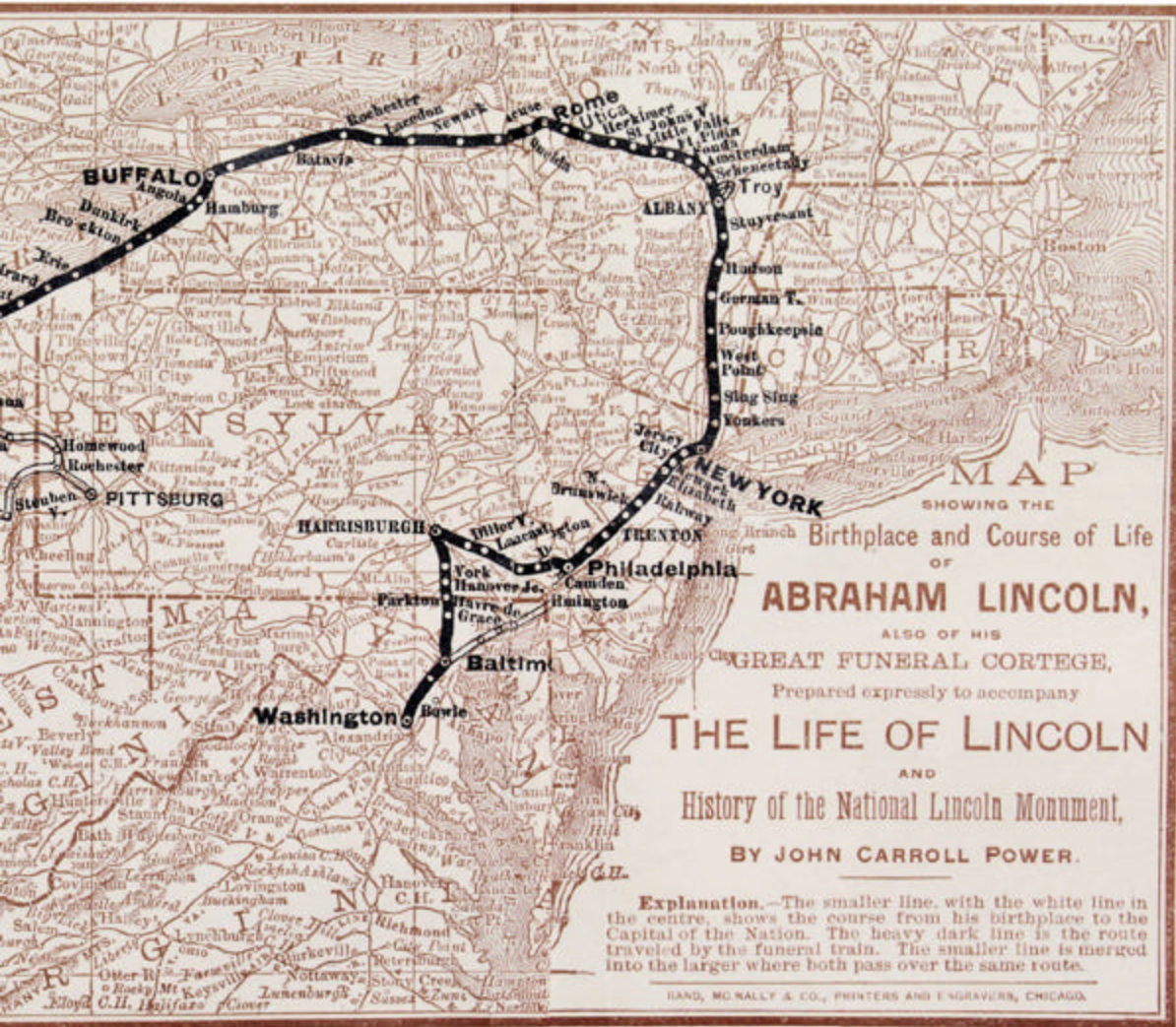
between four million people and liberty.

Today the old right-of-way on which Lincoln's train passed, closed to rail traffic in the 1980s, has become a hiking trail. Rusted rails emerge here and there from its grassy margins, then sink again into the sod. A wooden post, a bench, and a couple of picnic tables are all that mark the Mason-Dixon Line itself. I sit down on the bench, with the left half of me in the South and the right half in the North, marveling at the border's utter invisibility. I watch a pale green

inchworm as it traverses my shirtfront from Pennsylvania into Maryland, then doubles back and crosses the Mason-Dixon Line again.

Earth's most impassable barriers—as Lincoln the lawyer knew, as Lincoln the writer knew—are often those formed not of walls and trenches, nor even of mountains and oceans, but of laws and words. At this spot, as at no historic site I've visited, I feel the terrible arbitrariness of slavery. But Lincoln also knew that a line made of laws and words, no matter how formidable, could be





erased with new laws and words. He made this line cease to exist. No wonder newly freed African Americans lined the sides of these tracks throughout the first day of his funeral journey.

Invisible lines still cross the American landscape, of course—if not between slavery and emancipation, at least between different people's ideas of liberty. Lincoln and the Civil War are still a touchstone for many. A couple of miles north of New Freedom, back in my car now, I spot a Chevy Tahoe with a Confederate flag

bumper sticker and follow it into the parking lot across from the Mason-Dixon Restaurant. The driver is on his way to the liquor store, but he's happy to chat.

Keith Goettner is a retired state trooper, a lean man with a scraggly gray mustache and intense blue eyes; it's not hard to imagine him in an 1860s tintype. He had 13 ancestors who fought for the Union, he tells me, and three for the Confederacy—but he's cast his own allegiance with the Rebels. They stood for a certain kind of



***Everyone—white and black—knew that Lincoln’s role in ending slavery had spawned the murderous hatred that took his life.***

freedom, he says: “It’s about the right to choose to do what you want, as long as it’s legal. If you really dig into Confederate belief, they were very patriotic. They didn’t want war—they wanted to be left alone.”

There is irony, to say the least, in identifying the slaveholding Confederacy with personal freedom. But many people share Goettner’s view of liberty in this conservative section of rural Pennsylvania. Not far up the road, I stop at the Freedom Armory shooting range and gun store—“Your Second Amendment Connection,” its sign says—and meet the owner, a crew cut Louisiana transplant named Scott Morris. We chat politely across an immaculate glass case where the merchandise has names like Patriot, Savage, and Grenadier.

“I served in the military in Berlin during the Cold War, 110 miles behind the Iron Curtain,” Morris tells me. “On many different levels, I know what freedom is. Without the right to bear arms, we’d have no freedom.”

I ask Morris what he thinks about Lincoln and his legacy. “I appreciate a lot of the things he did,” he says. “But I wonder if we’re better or worse off today. We’d be better off with more states’ rights.”

In Lincoln’s day too this area was known for its Southern sympathies. But Philadelphia, which the funeral train reached on April 22, was a hub of abolitionism. The president lay in state at Independence Hall beside a black-shrouded Liberty Bell, which the antislavery movement had adopted as a symbol. Day and night some

100,000 mourners filed through the chamber where the Declaration of Independence and the Constitution had been signed.

Lincoln had made a memorable and strangely prophetic visit here four years earlier. In February 1861, on his way to his first inauguration and with war imminent, he raised the American flag at dawn over the venerable building. In brief, impromptu—and still little remembered—remarks to the crowd, Lincoln spoke powerfully about the meaning of the declaration.

The document wasn’t merely about freeing Americans from Britain, he said. Rather there was “something in that Declaration giving liberty, not alone to the people of this country, but hope to the world for all future time. It was that which gave promise that in due time the weights should be lifted from the shoulders of all men, and that all should have an equal chance.” A moment later he added: “If this country cannot be saved without giving up that principle—I was about to say I would rather be assassinated on this spot than to surrender it.”

Lincoln’s words still resonate strongly with Ada Bello, who met me at Independence Hall. Beginning in the 1960s she and other activists gathered here for some of the first gay-rights demonstrations in American history. Back then a few dozen marchers were often outnumbered by wary police and catcalling onlookers. Now a state historical marker honors the protesters—and just a few weeks before my visit, Pennsylvania began allowing same-sex couples to marry.

The stories of the soft-spoken, 81-year-old Bello sound almost like tales of the Underground Railroad. In the early days of the movement, which she joined after immigrating to the U.S. from her native Cuba, the very idea of homosexual rights seemed to most Americans laughable at best, dangerous at worst—except to the men and women whose lives were stunted by persecution and secrecy. Police regularly raided the city’s gay bars; public exposure ended careers and drove some people to suicide. “Marriage wasn’t even in the realm of possibility.”

Although that idea would have seemed even more far-fetched in Lincoln’s time, Bello

In the 1860s—when the nation's rail system was a tangle of small local lines—transporting the funeral car halfway across the continent was a technical feat. Two dozen different locomotives, including this one in Ohio, drew the train.

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doesn't hesitate to claim him as a kindred soul. America's 18th-century founders framed grand but imperfect ideas in this building, she says. "I think Abraham Lincoln actually realized that unless you apply those principles to everybody, it's a false promise. He understood the need to bring other minorities in."

**H**e died for me! He died for me! God bless him!" Those words, spoken through tears by an elderly woman as she watched Lincoln's coffin pass through the streets of lower Manhattan, captured how she and many other African Americans felt about the president's death. Everyone—white and black—knew that Lincoln's role in ending slavery had spawned the murderous hatred that took his life. Understandably, African Americans hoped to take their places in the front ranks of the mourners; more than 5,000 planned to march in New York City. But many white Americans had different ideas.

Several days before the funeral train arrived, municipal authorities decreed that no black marchers would be allowed in the procession. Edwin Stanton, the secretary of war, sent a furious telegram from Washington overruling the ban, but the intimidation had worked. The vast parade down Broadway on April 24 included Irish firemen by the thousands, German marching bands, Italian social clubs, Roman Catholic priests, and Jewish rabbis, as well as special delegations of bakery employees, cigarmakers, Freemasons, glee club members, and temperance activists. A couple of hundred African Americans brought up the very rear.

To retrace Lincoln's funeral route today is to be reminded often of that bitter lesson. In Buffalo I visit the city's 19th-century landmarks: not just the terminus of the Erie Canal, once the gateway to the West, but also relics such as the Michigan Street Baptist Church, built in the 1840s as a hub of the city's intellectually vibrant and politically active black community.





Near Philadelphia, this section of Amtrak's busy Northeast Corridor line runs along the 19th-century rail route. Bells tolled and cannon fired salutes at every town and village along this part of the journey.

*In this and like communities, public sentiment can fail; without it, nothing can succeed.*





*is everything. With public sentiment, nothing*

—Abraham Lincoln, first Lincoln-Douglas Debate, August 21, 1858

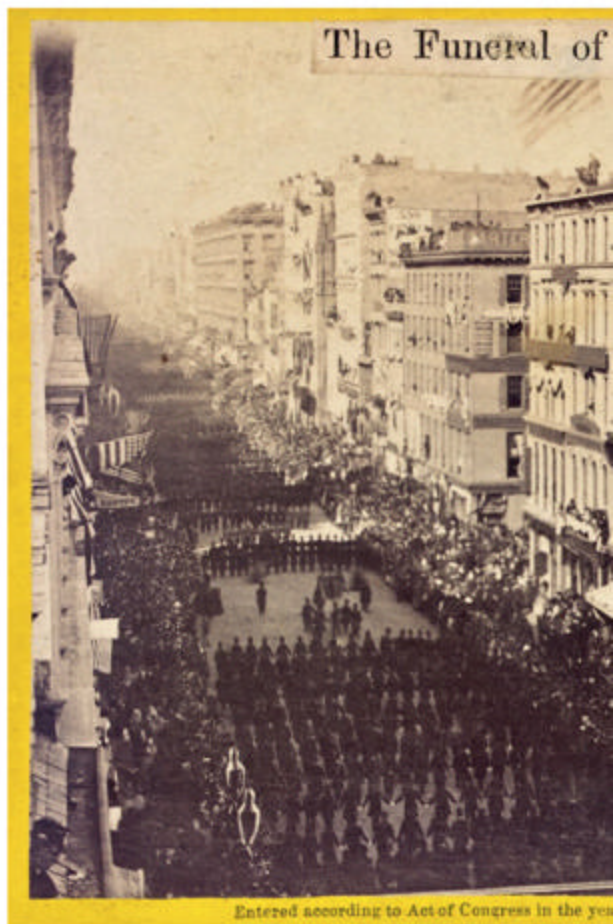


Nationally renowned activists and preachers spoke in the handsome, sun-drenched sanctuary; fugitive slaves took shelter in the basement. Over the next century, a neighborhood of shops, restaurants, and clubs grew and flourished in the surrounding blocks.

Today Buffalo is one of the poorest cities in the nation and among the most racially balkanized. The old church stands marooned in a bleak urban landscape. Its present-day pastor, Bishop Clarence Montgomery, tells me that only half of the city's young African Americans finish high school. Despite a few glimmers of hope—such as a historic jazz club that now houses an impressive museum of Buffalo's rich musical heritage—most of the surrounding blocks are dominated by vacant storefronts, public housing, and shotgun-style houses. I'm surprised when, just a few blocks north along Michigan Avenue, the urban decay gives way to another world: a strip of gleaming hospital buildings and offices, with more under construction nearby. It's the city's new medical corridor, a promising sign of economic recovery—except that almost everyone I see, from the patients to the medical workers to the construction crews, is white.

"Michigan Avenue is becoming our Mason-Dixon Line," says George Arthur, a former city council president and longtime leader among local African Americans. "The medical corridor is bringing prosperity to the white community, but almost none of that reaches our black community, which has one of the highest unemployment rates in the country."

Indeed, Arthur tells me that when it comes to racial disparities, history seems to move backward as often as forward. "One of the first lawsuits in America to integrate public schools started in Buffalo in 1868," he says. That effort succeeded, but by the time Arthur entered politics nearly a century later, *de facto* segregation had long since returned to the schools. He helped lead a successful movement to integrate them in the 1970s. "But now the schools have resegregated again, and we're back in the same boat as in the '60s," he observes. "Both the 1960s and the 1860s, take your choice."



On its journey up the Hudson River, across the Empire State, and down the shores of Lake Erie, Lincoln's funeral train rode the same rail corridors that Amtrak now uses. In fact, even as the journey unfolded, the railroad baron Cornelius Vanderbilt was at a critical moment in his struggle to forge a single corporate dominion out of antebellum America's dozens of small local lines.

In 1860s America the railroad was more than just a new technology—it was a kind of national cult. A few months before the end of the Civil War, the abolitionist leader William Lloyd Garrison waxed mystical about the revolution that trains had brought, fostering not just economic prosperity but also human connection on a vast scale: "So may the modes of communication

Millions of Americans who didn't witness the funeral pageantry in person still caught vivid glimpses via new technology. Placed in a stereoscope, this double image offered a 3-D view of the cortege passing down Broadway.

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and the ties of life continue to multiply, until all nations shall feel a common sympathy and worship of a common shrine!”

Little remains of the Civil War-era railroad network traveled by the funeral train between Columbus, Ohio, and Chicago, Illinois. But as I get accustomed to the landscape, I find I can sense the railroad like a vanished limb: a downtown street that’s wider than it needs to be, a vacant lot beside a grain elevator, a long straight groove through the middle of a farmer’s soybean field. I’ll pull over, find a telltale scatter of old gravel and broken glass, and tell myself, Lincoln passed here too.

Sometimes at these places I find signs warning of buried fiber-optic lines. Data companies often use the old railroad rights-of-way to run

their cables—just as, in the late 1850s, telegraph companies ran their wires here. The multiplication that Garrison prophesied continues apace.

Even in these remote hamlets, people would have known of John Wilkes Booth’s crime just hours after the assassin’s bullet found its mark. Two weeks later, when the train came, they knew to expect this rendezvous with the dead president. The train traveled by night between the big cities—but not in darkness, for at almost every rural crossing, bonfires blazed. At three o’clock, four o’clock in the morning, as many as ten thousand people gathered at some village depots, an unimaginable thing in a time and place where life was still lived mostly from sunup to sundown. Bands played dirges as the farmers and their families waited in the chill. In Greenfield, Indiana,





Lincoln's funeral train made a brief stop in Syracuse, New York, on April 26, 1865. Today black and white parishioners worship together at Grace Church, one of the city's first congregations to become integrated in the 1950s.









*As I would not be a slave, so I  
would not be a master. This  
expresses my idea of democracy.*

*—Abraham Lincoln, written fragment, ca August 1, 1858*

A toy in Tilda Pegg's yard in Straughn, Indiana, belonged to her son, now a grown man. When the funeral train passed through in the predawn hours of April 30, two coffins were inside: Lincoln's and the exhumed remains of his young son Willie, who died of typhoid in 1862.







***Mourners collected  
relics as if of a saint.  
Within hours of Lincoln's  
death, a bit of his blood-  
stained shirt would  
fetch a \$5 gold piece.***

word came by telegraph that the train was just a few miles up the line. A young veteran, to pass those last minutes, read Lincoln's Second Inaugural aloud to the throng. As the black locomotive approached, the town minister led a prayer. Then firelight flickered briefly on the funeral car itself, the glossy paint and silver-fringed crepe, the small windows revealing nothing of the awful cargo within. Nearly everyone was weeping now. At last a whistle sounded, and the machine, and history, passed on.

**P**ace looks like this: On a warm Sunday afternoon, on an artificial lake in suburban Chicago, people are paddling a boat. It's only when they're back onshore that I notice one of them is limping. He's young and athletic, but he leans on a cane like an old man.

The young veteran is Brad Schwarz, who will spend the rest of his life with the consequences of what happened to him one morning in Iraq, in the fall of 2008. That's when the Humvee he was riding in struck an improvised bomb. He survived, albeit gravely wounded in body and psyche. Back home he slept with one loaded pistol under his pillow and another in the bedside dresser. One night he awoke from a nightmare to find that he was slamming his wife's head against the wall, hallucinating that she was an attacker.

Schwarz tells me that he was always interested in history and that when he first volunteered to serve in Iraq, he felt as if he was participating in one of the great events of his era, much as soldiers in the Civil War or World War II had

done. But that soon changed. "While I was there, I didn't feel like I was participating in history—I was just doing my job," he tells me. "And I didn't think we were changing anything for the better. I lost so many friends and spilled my own blood and tears and sweat there, and sometimes I feel like it was for nothing."

The Civil War felt equally pointless and awful to many Americans in the spring of 1865. The conflict had been self-evidently unnecessary, a matter not of foreign invasion but of domestic politics gone badly awry. Now three-quarters of a million men were dead. Many families never had a body to bury or a relic to cherish: So many boys and men had simply vanished into the mud of Virginia or Tennessee.

Perhaps that was why Americans mourned Lincoln's Good Friday martyrdom with such intensity. "People were still getting notice of their loved ones' dying," says historian Martha Hodes, author of *Mourning Lincoln*, a new book on the president's death and its aftermath. "Lincoln's funeral was like a stand-in for the brother or son or father whose body would never come home." Perhaps that's also why people cared so much about not just seeing Lincoln's coffin pass but filing past to view his corpse—and why the casket was not closed even when, after two weeks, the embalming techniques of the day began to fail and the dead man's face turned dark and sunken.

Mourners collected relics as if of a saint: a snippet of drapery from the catafalque, a scrap of crepe from the funeral train. Within hours of Lincoln's death, a bit of his bloodstained shirt would fetch a five-dollar gold piece. Many of these souvenirs survive in museums today. But what I find most affecting are the remnants of wreaths and bouquets still preserved after a century and a half. A single leaf of laurel, a rosebud faded to rusty orange: slain offerings, as if springtime itself had been offered as a sacrifice.

The train's last stop before Springfield was, appropriately, the town of Lincoln, Illinois, 30 miles north. More than a decade earlier, when the future president was still a state legislator, it had become the first of the many American towns that would be named in his honor.

I stop in Lincoln myself late one afternoon. It's a sleepy place, the Victorian storefronts gone shabby. The main square, with its hulking courthouse, is nearly deserted except for a few teenage kids circling on their low-slung bikes, idly popping wheelies and bucking down a low flight of stairs. At a corner of the big old building, I spot a white marble column: the kind of Civil War monument I've seen in almost every county seat these past thousand miles and more.

A hundred years of acid rain have eroded the names of the dead men and their fatal battles, leaving the monument looking like a relic of ancient Egypt or Babylon, not a memorial to the grandfathers' grandfathers of men and women alive in the town today. Blurred fragments of words emerge: "TOMLINSON ... DAVIS ... SHILOH." A more recent marker nearby quotes a local newspaper article from April 1862, a year into the war: "It takes but small space in the columns of our paper to report the 'killed and wounded' from our county, but oh! ... Every name in the list is a lightning stroke to some fond heart."

As I stop to read, one of the bike-riding teenagers, a scruffy blond kid wearing a baseball cap backward, coasts up and asks what I'm doing. Before long, he's spilling out stories about Lincoln—the town and the president ("Abraham," he says familiarly) all mixed up together. Tim Evans is 17, an 11th grader with a jumble of plans for the future. He wants to be an architect. He wants to be an underwater welder. He wants to go pro with his stunt biking. I point to the marble column and ask if he's ever thought of the military. "Sometimes," he says doubtfully. But he's got other plans. Just like the names on this monument, I think, just like the three-quarters of a million other names on other monuments—each one the remnant of a life once as complicated, as tentative, as optimistic as this one.

Lincoln was buried at last in Springfield on May 4, nearly three weeks after his death. Townsfolk draped black bunting over the simple frame house that he had last seen on the morning he departed for the presidency. They tracked down his favorite horse, the one the

Lincolns had named Old Bob, which had been sold into service pulling a wagon. The animal walked in the procession to the cemetery, led by a local African-American minister who had worked for the Lincolns as a handyman.

The tomb, I find, is a disappointment. Twice reconstructed since 1865—most recently, in the 1930s, in incongruous Art Deco style—its current incarnation has all the historic character of an office lobby. (The coffin was moved no fewer than 14 times in the decades after its original burial, as if no one could figure out quite what to do with it.) Lengthy inscriptions on the wall, relics of their time, recount nearly every biographical detail except the Emancipation Proclamation. The body, a guide tells the crowd of tourists, lies under ten feet of concrete. It's strange to think that there is a place where Lincoln still physically exists in the world, let alone that it's a place like this.

Several hours later I make my way to another graveyard a few miles distant. There's not a living soul at this one when I arrive, just row upon row of identical white headstones. Here at Camp Butler National Cemetery are buried more than a thousand Civil War dead, mostly men who died of disease under miserable conditions at the nearby training camp and military prison. All are equal beneath the clean-cut marble slabs: officers and privates, black men and white. Northerners and Southerners too, for here are hundreds of Confederate prisoners: Texas cavalymen, Arkansas infantrymen, teenage boys from Tennessee and Alabama, stranded far from the soil they fought to defend.

Many of the stones bear no names, but most have dates. I begin to notice an unusual number from the spring of 1865; perhaps an epidemic swept the camp then. There's a whole section from the first week or two of April, including a few dated April 14 and 15, the same time as the assassination in far-off Washington. One of these is for a soldier of the U.S. Colored Troops.

If the choice were mine, Lincoln too would rest here, side by side with such comrades, among the thickly clustered ranks of these honored dead. □








Henry and Mahesha Langstraat dress their one-year-old son, Marley, in Brooklyn. Race relations have progressed since Lincoln abolished slavery, though more than 100 years passed before laws criminalizing interracial marriage were struck down by the U.S. Supreme Court.





*These men ask for... the same  
thing: fairness, and fairness  
only. This, so far as in my power,  
they, and all others, shall have.*

*—Abraham Lincoln, letter, May 30, 1860*

In Philadelphia, about a mile from the funeral route, Abdoulaye Ndiaye—whose family emigrated from Senegal—plays football for the Abraham Lincoln High School Rail Splitters. Some 200 American towns and cities, and more than 600 schools, are named in memory of the 16th U.S. president.

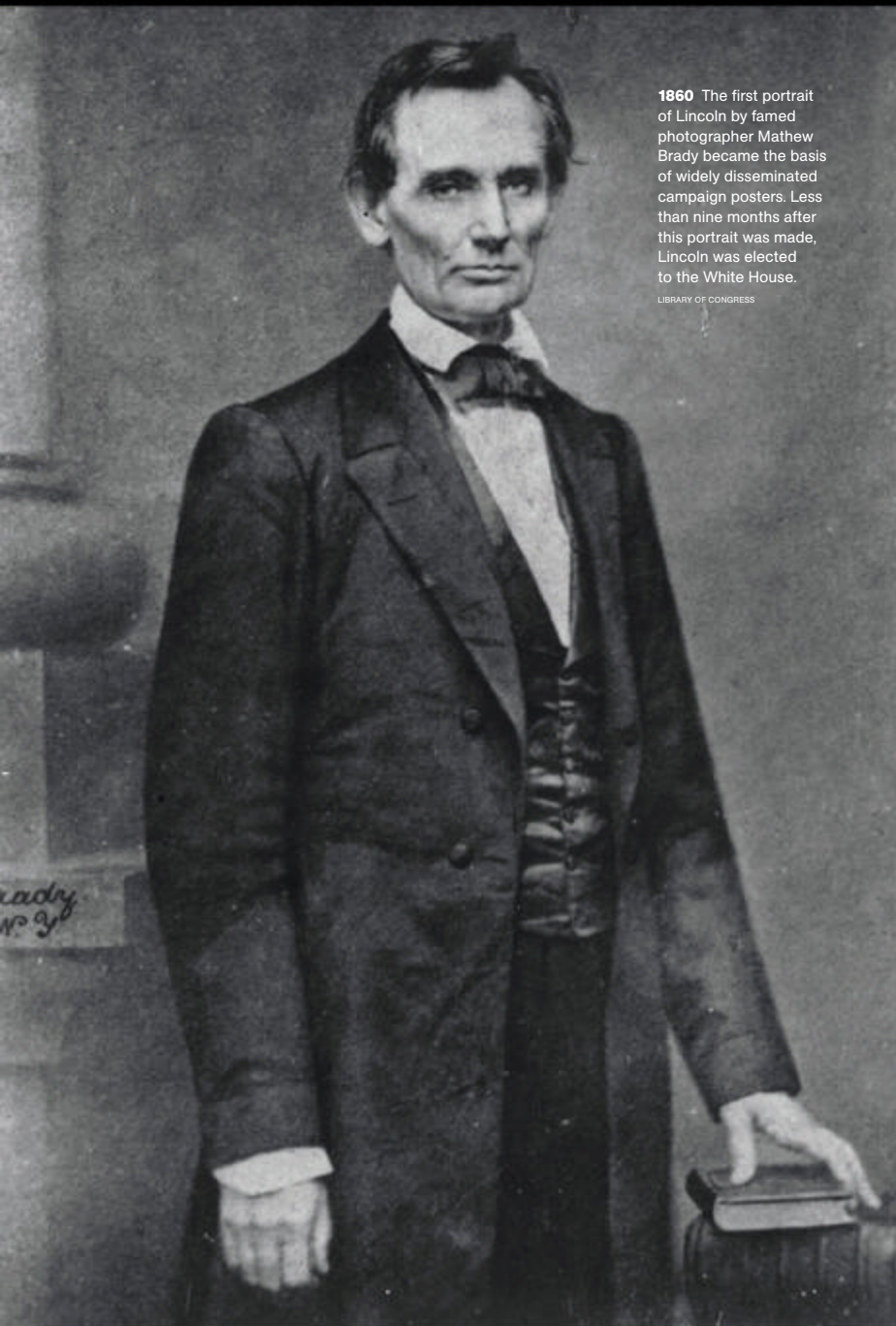


ATTITUDE IS  
EVERYTHING

EXIT

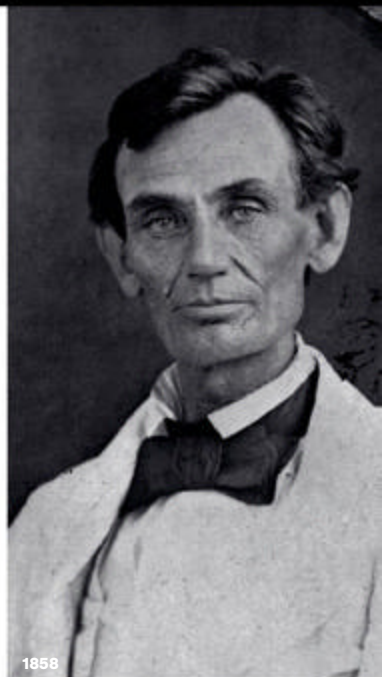




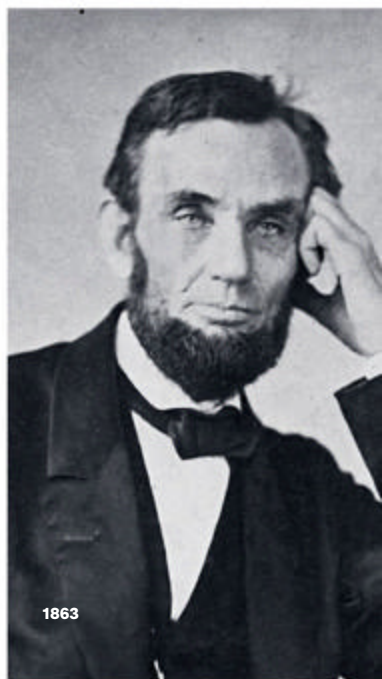


**1860** The first portrait of Lincoln by famed photographer Mathew Brady became the basis of widely disseminated campaign posters. Less than nine months after this portrait was made, Lincoln was elected to the White House.

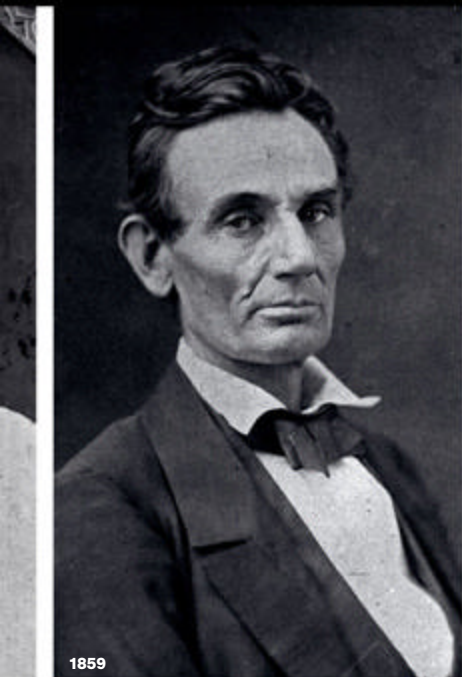
LIBRARY OF CONGRESS



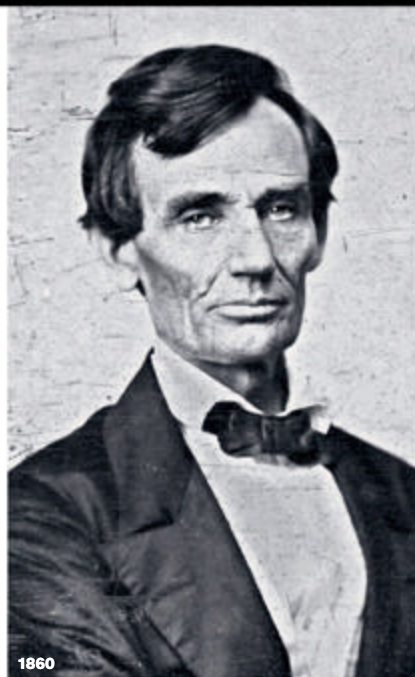
1858



1863



1859



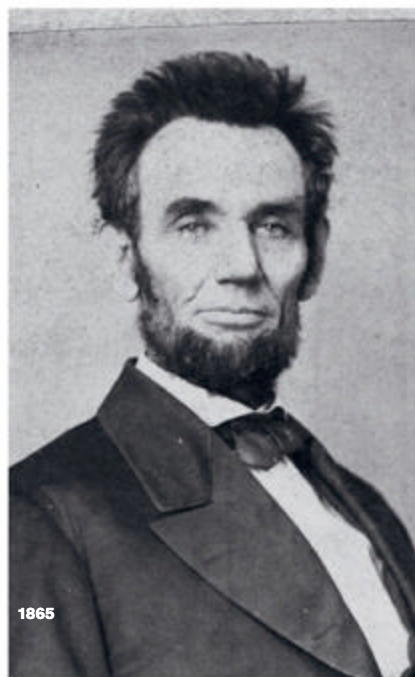
1860



1860



1864



1865

Lincoln the politician understood the power of a portrait. As this gallery shows, he sat for many during the last years of his life. In 1858, at age 49, Lincoln the lawyer (top left, in linen suit) argued and won his most celebrated criminal case; later that year he lost a second bid for the U.S. Senate. During the presidential campaign of 1860, an 11-year-old supporter urged candidate Lincoln to grow a beard, "for your face is so thin." He heeded the girl's advice, as seen in a photograph made almost three weeks after his election (above). In subsequent portraits Lincoln shows the mounting strain of leading a nation sundered by civil war. Early in 1865 he had his hair trimmed to keep it out of the plaster used to make his second and final life mask.

TOP ROW, FROM FAR LEFT: ABRAHAM M. BYERS; ART ARCHIVE/CULVER PICTURES/ART RESOURCE; NY. SAMUEL M. FASSETT; LIBRARY OF CONGRESS. PRESTON BUTLER; LIBRARY OF CONGRESS. SAMUEL G. ALSCHULER; LIBRARY OF CONGRESS. BOTTOM ROW: ALEXANDER GARDNER; LIBRARY OF CONGRESS. MATTHEW BRADY; GETTY IMAGES. LEWIS E. WALKER; LIBRARY OF CONGRESS




## LINCOLN

### HIS FACE WEARS THE STRUGGLES OF A NATION

**I**t is a face handsome and homely, sorrowful and mirthful, penetrating and opaque. Amid the contradictions stamped into nearly a half trillion pennies is one truth: Abraham Lincoln's face is unforgettable. But it is a visage that we, 150 years after his death, will never truly know. Lincoln's personal secretary, John G. Nicolay, described "the long gamut of expression from grave to gay, and back again from the rollicking jollity of laughter to that serious, far-away look that with prophetic intuitions beheld the awful panorama of war, and heard the cry of oppression and suffering." Perhaps this is why Nicolay wrote:

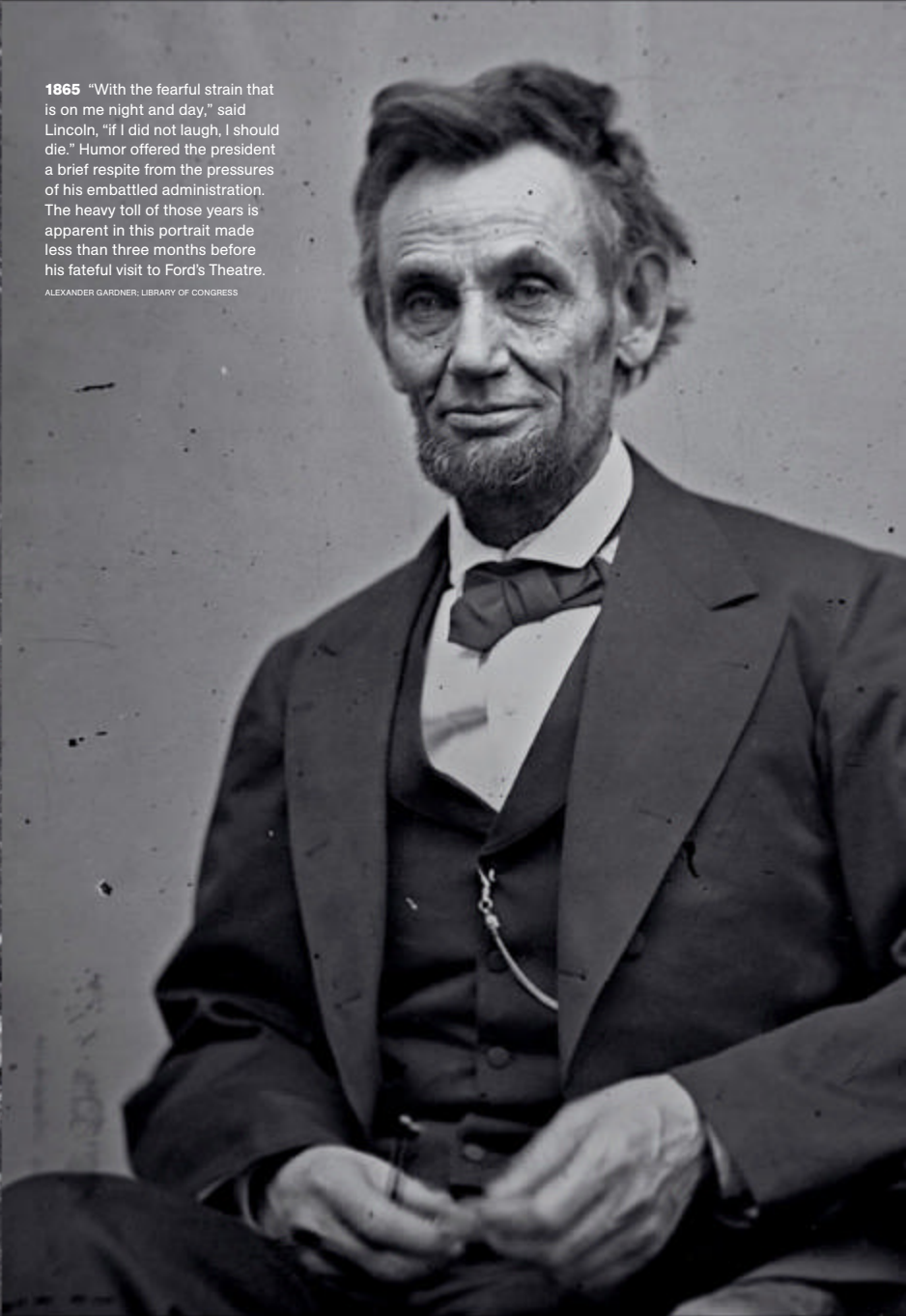
“There are  
many pictures  
of Lincoln;  
there is  
no portrait  
of him.”





**ca 1846** Born in poverty and "raised to farm work," Lincoln the rough-hewn rail-splitter had, by age 37, become a prosperous lawyer in Springfield, Illinois. This daguerreotype, made shortly after he was elected to the U.S. Congress, is his earliest confirmed portrait.

NICHOLAS H. SHEPHERD, LIBRARY OF CONGRESS



**1865** "With the fearful strain that is on me night and day," said Lincoln, "if I did not laugh, I should die." Humor offered the president a brief respite from the pressures of his embattled administration. The heavy toll of those years is apparent in this portrait made less than three months before his fateful visit to Ford's Theatre.

ALEXANDER GARDNER, LIBRARY OF CONGRESS





# HUBBLE'S GREATEST HITS

*Pictures from the space telescope have dazzled us for 25 years.  
Now, Hubble's lead imaging scientist picks his top 10 celestial views.*





**COSMIC FIREWORKS** Sparkling with energy, a cluster of young stars lights up a cavity in the roiling dust of the Tarantula Nebula. For Zoltan Levay, charged with bringing Hubble Space Telescope imagery to the public, the scene's dynamism is irresistible. "Stars are being born, stars are dying," he says. "There's a vast amount of material churning."

NASA; ESA; F. PARESCE, INAF-IASF, BOLOGNA, ITALY; R. O'CONNELL, UNIVERSITY OF VIRGINIA; WIDE FIELD CAMERA 3 SCIENCE OVERSIGHT COMMITTEE





**STAR POWER**

Hubble's Wide Field Camera 3 looks through the Horsehead Nebula in a uniquely detailed infrared image. A classic target of astronomy, the nebula normally appears dark against a bright background, but Hubble penetrates the shroud of interstellar dust and gas. It's a hint of what to expect from NASA's planned infrared James Webb Space Telescope, Levay says.

MOSAIC OF FOUR IMAGES  
NASA, ESA; HUBBLE HERITAGE  
TEAM, STSCI/AURA







**Zoltan Levay,**  
Space Telescope  
Science Institute  
(STScI) imaging team  
leader, has worked  
on Hubble images  
since 1993. These  
are his ten favorites.

PHOTO: REBECCA HALE,  
NGM STAFF





# 8

## **GALACTIC WALTZ**

The interplay of their gravitational forces bends two spiral galaxies, collectively known as Arp 273, as they approach and prepare to merge 300 million light-years away. "It looks to me like they're in a dance," Levay says. "They'll orbit around each other for eons and finally come together."

NASA, ESA, HUBBLE HERITAGE TEAM, STSCI/AURA



By Timothy Ferris

# I t didn't amount to much at first.

Launched into orbit aboard the space shuttle *Discovery* on April 24, 1990, amid flurries of hope and hype, the Hubble Space Telescope promptly faltered. Rather than remaining locked on its celestial targets, it trembled and shook, quaking like a photophobic vampire whenever sunlight struck its solar panels. Opening its protective front door to let starlight in perturbed the telescope so badly that it fell into an electronic coma. Worst of all, Hubble turned out to be myopic. Its primary light-gathering mirror, eight feet in diameter and said to be the smoothest large object ever fashioned by humans, had been figured perfectly wrong.

Its design was already a compromise. The astronomers had wanted a bigger telescope in a higher orbit. They got a smaller one orbiting only 350 miles high, so that it could fit in the shuttle's cargo bay and remain within reach for servicing by astronauts working in space. Some grumbled that science was being subordinated to flyboy flash.

Yet the shuttle proved to be the mission's salvation. Had Hubble been lofted beyond the shuttle's reach, it might have gone down in history as a billion-dollar blunder. Instead it was constructed so that its key components, from cameras and computers to gyroscopes and radio transmitters, remained accessible for replacement or repair. One astronaut took this requirement so seriously that he visited the Smithsonian's National Air and Space Museum after-hours, put a ladder up to its Hubble replica, and practiced swapping out instruments to make sure everything fit. Everything did, and five nearly perfect shuttle service missions proved essential in transforming Hubble from a 12-ton dud into one of the world's most productive and popular scientific machines.



**NEAR AND FAR**

In a deep-focus image, bright stars shine nearby in the Milky Way. Most of the other stars shown, including the cluster at bottom, are in the Andromeda galaxy. Billions of light-years beyond, entire galaxies glow. Levay: "It may not look like much, but what we see is nothing less than the entire sweep of the cosmos in a single image."

NASA; ESA; T. M. BROWN, STSCI



Hubble literally expanded the frontiers of human knowledge. Using it to peer deep into space and back in cosmic time with unprecedented clarity, astronomers learned that galaxies formed from smaller patches of stuff in the early universe (“bottom-up,” in the terminology of researchers who’d wrestled with this issue for decades) and that massive galaxies typically harbor supermassive black holes at their centers. Hubble examinations of dim dwarf stars confirmed that normal matter cannot generate nearly enough gravity to hold galaxies together, which means that the “dark matter” responsible must be made of more exotic stuff. Hubble measurements of galaxy velocities yielded early clues to the existence of “dark energy,” the mysterious force currently speeding up the cosmic expansion rate.

Just recently, Hubble researchers have captured light from a newborn galaxy seen as it looked 13 billion years ago, taken the temperature of a hot planet orbiting a star 260 light-years from Earth, and discovered three icy objects in the outer solar system that might provide an even farther-out destination for NASA’s New Horizons probe after it flies past Pluto in July.

The space telescope’s global popularity surely arises, though, not only from its scientific attainments but also from the memorable images it has produced of glittering galaxies, softly glowing nebulae, and the wreckage of shattered stars. While Hubble was being built and launched, such photos were routinely disparaged in NASA circles as mere public relations fodder, called “pretties.” But a quarter century later the cosmic scenes assembled by Zoltan Levay and his colleagues at the Space Telescope Science Institute have, in the words of NASA historian Steven J. Dick, “enhanced the very idea of what we call ‘culture.’” That human beings find them to be as beautiful and evocative as photos of earthly sunsets and mountain peaks affirms anew that nature is all of a piece, and that we’re part of it. □

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*Timothy Ferris frequently reports from the universe for the magazine. His last story, on dark matter and dark energy, appeared in the January 2015 issue.*



6

#### CELESTIAL WINGS

Gas from a dying star resembles a butterfly, its lacy wings formed by the ejection of its outer layers. Unique and colorful planetary nebulae like NGC 6302 have provided some of Hubble’s most popular images. “They’re beautiful,” Levay says, “but some very complex dynamics and phenomena shape these things.”

NASA; ESA; HUBBLE SM4 ERO TEAM



**SPECTRAL VISION**

What looks like a ghostly ring suspended in the heavens is really a gas bubble 23 light-years across, the remnant of a supernova explosion first observed in our sky 400 years ago. "The simplicity of this image is haunting," says Levay, "but deceptive." Myriad forces ripple the bubble's surface and distort its shape.

NASA; ESA; HUBBLE HERITAGE TEAM,  
STSC/AURA. J. HUGHES, RUTGERS  
UNIVERSITY



4

**ECHO OF LIGHT**

Over several months in 2002, Hubble captured a cosmic spectacle—a ragged balloon of dust that appeared to expand around the star V838 Monocerotis. In reality, an expanding blast of the star's light was illuminating the dust cloud. Levay: "It's rare to be able to watch something change this dramatically on a human timescale."

NASA; ESA; H. E. BOND, STSCI

**MORE ONLINE**

[ngm.com/more](http://ngm.com/more)

**TELEVISION*****See Hubble's  
History Unfold***

Tune in to the National Geographic Channel on April 20 for *Hubble's Cosmic Journey*. Narrated by Neil deGrasse Tyson, the special covers the telescope's 25-year history, from conception to major events.

**INTERACTIVE GALLERY**

**Now it's YOUR turn.**

**Browse our extended gallery of Hubble images, then tell us which ones are your favorites—and why.**





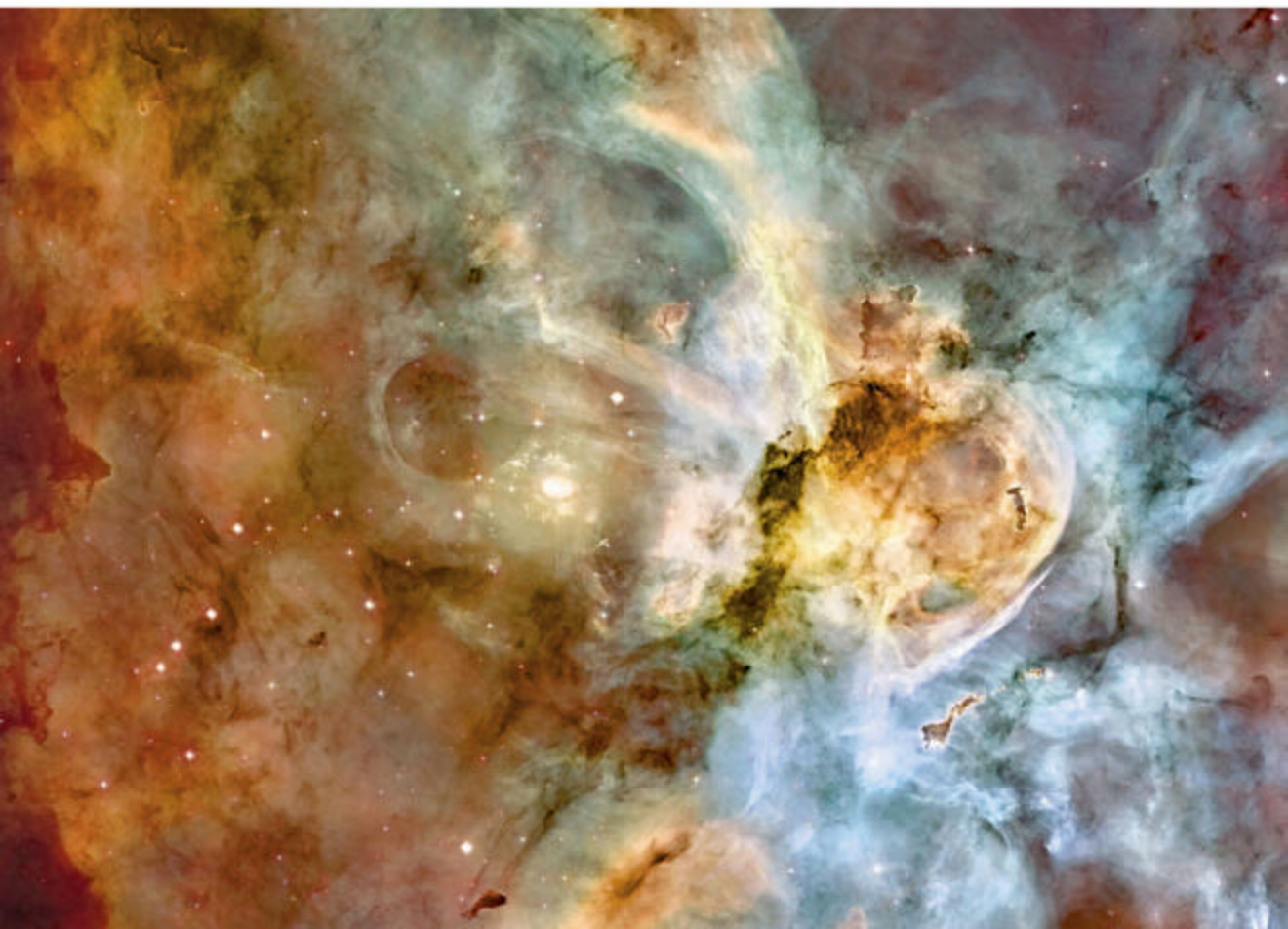


3

#### HATS OFF

This spectacular image of the spiral Sombrero galaxy, seen almost edge on from Earth, holds a “large emotional connection” for Levay. He remembers fondly a college professor who recounted awestruck nights viewing the galaxy through an observatory telescope.

MOSAIC OF SIX IMAGES. NASA; HUBBLE HERITAGE TEAM, STSCI/AURA





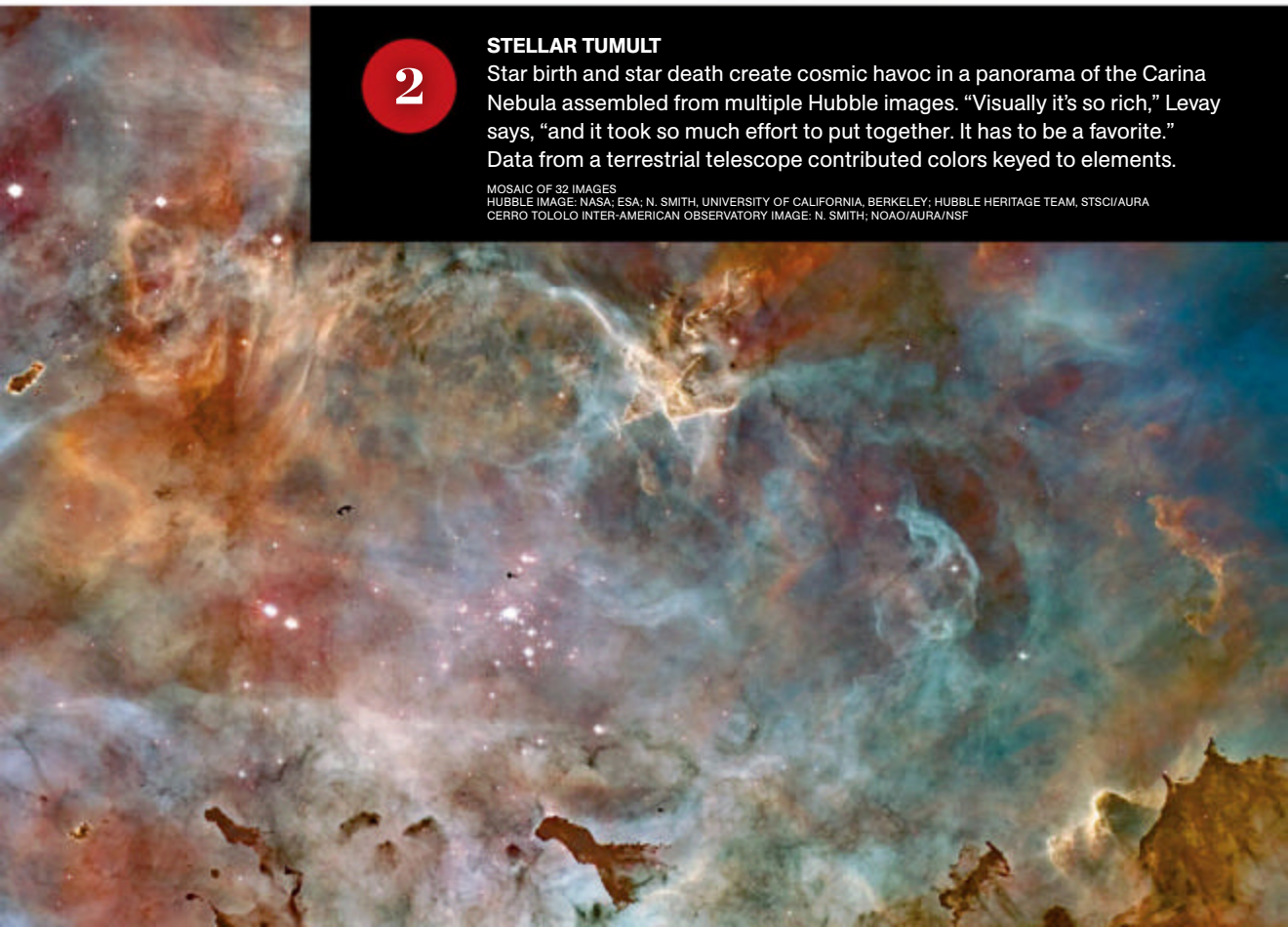


2

### STELLAR TUMULT

Star birth and star death create cosmic havoc in a panorama of the Carina Nebula assembled from multiple Hubble images. “Visually it’s so rich,” Levay says, “and it took so much effort to put together. It has to be a favorite.” Data from a terrestrial telescope contributed colors keyed to elements.

MOSAIC OF 32 IMAGES  
HUBBLE IMAGE: NASA; ESA; N. SMITH, UNIVERSITY OF CALIFORNIA, BERKELEY; HUBBLE HERITAGE TEAM, STSCI/AURA  
CERRO TOLOLO INTER-AMERICAN OBSERVATORY IMAGE: N. SMITH; NOAO/AURA/NSF







# 1

## PEERLESS BEAUTY

This iconic Hubble image of the spiral galaxy NGC 1300 is suffused with detail—bright blue young stars, the dust lanes spiraling around the bright nucleus, distant galaxies shining through. “You can just lose yourself in it,” says Levay. Many have.

MOSAIC OF TWO IMAGES  
NASA, ESA, HUBBLE HERITAGE TEAM,  
STSCI/AURA, P. KNEZEK, WIYN









Coal worker Ajay Marijan carries a load from an open-pit mine to a waiting truck in Bokapahari, Jharkhand state.



A person's arm and hand are visible on the left side of the frame, holding a large, dark, jagged piece of coal. The background is a vast, dark, and desolate landscape of a coal mine, with a small, shallow pool of water reflecting the sky in the center. The ground is covered in dark, uneven terrain, likely coal dust and rocks.

# How Coal Fuels India's Insurgency

*In mineral-rich jungles Maoist militants  
find a foothold through violence and extortion.*









Indigenous women pose in front of a painted scene at the annual festival in the village of Orchha, in Chhattisgarh state's Abujmah forest—the main base of the Maoist rebels known as Naxalites.









At an ad hoc restaurant, men prepare breakfast for workers clocking in for the morning shift at the coal-based Jindal Tamnar thermal power plant, in the Raigarh district, Chhattisgarh.



By Anthony Loyd

Photographs by Lynsey Addario

The gunman at the jungle's edge lived and died by different names. Some knew him as Prashant, others as Paramjeet. Occasionally he called himself Gopalji, trading the alias with another insurgent leader to further confuse the Indian authorities trying to hunt him down.

When I met him, he was fresh from killing, and called himself by yet another name. "Comrade Manas," he said as he stepped from the shadows beneath a huge walnut tree, machine gun in hand, a slight figure, his frame and features burned out and cadaverous with the depredations of malaria and typhoid, war and jungle.

The day was already old and the sun low. The silhouettes of a dozen or so other gunmen lurked in the deepening green of the nearby paddy fields, watchful and waiting. Manas and his men were on the move and had little time to talk.

In India they are known by a single word, Naxalites: Maoist insurgents at the heart of the nation's longest running and most deeply entrenched internal conflict. Their decades-long war, which costs India more lives today than the embers of the conflict in Kashmir, has been described by former premier Manmohan Singh as India's "greatest internal security threat."

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*Anthony Loyd is a special correspondent for the Times of London, where he has worked for 22 years. Photojournalist Lynsey Addario's memoir, It's What I Do (Penguin Press), came out in February.*

Standing in the back of a truck, a man collects the body of his son, Nakul Munda, in the village of Heso in Jharkhand. Naxalites shot the teenager for allegedly being a police informant.



In the spate of violence 24 hours before our rendezvous, Manas, just 27 years old, and his men had killed six policemen and wounded eight more in an ambush across the range of low hills at whose base we now met.

The attack had put the Naxalites back on the front pages of India's newspapers, and security forces were on the move in angry response. Patrols and helicopters circled the area, sweeping through villages and probing into the jungle.

By rights, the Naxalites should have been relics of history, rather than fighting and killing in the name of Mao long after the Chinese communist leader's death, in a country he had never even visited—a nuclear power at that. Yet their war, fought in the back blast of India's energy boom, had been thrown a lifeline by the demands of development and the globalized



economy, as mineral exploitation and land rights became catalysts of a revitalized struggle.

In this way India's energy needs and industry's hunger for raw materials linked the angry killers in the jungle to coal, steel, and power production, welding the Naxalites to some of the most disadvantaged communities in the country—the Adivasis, India's original tribal dwellers. Rather than becoming an anomaly from the past, the Naxalite insurgency—fueled by intimidation, extortion, and violence—has come to symbolize a conflict prophetic of the future. It pits development against tradition, with India's most mineral-rich states at the epicenter.

Indeed Manas, already a Naxalite “zone commander” despite his youth, seemed certain that the social grievances of the poor would eventually ensure victory for his cause. He regarded

the overthrow of the Delhi government as an inevitability.

“An adult tiger grows old and dies,” he assured me, his eyes glowing with the luminosity of radicals the world over, “just as the government we are trying to oust is old, decaying, and ready to die. Our revolution is young and bound to grow. These are the laws of the universe. In a battle between politicians and a new society run by the people, the people are bound to win.”

He spoke until the last of the sun had dipped beneath the tree line, and then he slipped off into the shadows with his men. The security forces were getting closer, and they had no wish to become encircled.

The next time I saw his face, Manas was dead. It stared at me from a roadside shrine in the impoverished village where he had been



born. Local people told me that he had been slain in a gun battle not long after our meeting. Only by reading the inscription on the stone did I learn the real identity of the insurgent with many names: Lalesh.

THE NAXALITES' WAR always began where the road ended. Everyone said so. Manas boasted to me that it had been six years since he had seen a paved road. The police, the political officers, the paramilitaries, the Adivasi tribes, the poorest local farmers, and the Naxalites themselves: It was the one thing they agreed upon.

There always came a point out there in those jungles of India's infamous Red Corridor—

## **Government informers were tried in people's courts and killed with axes or knives.**

foremost among them in the states of Chhattisgarh and Jharkhand—where the road began to give up the struggle against the thrust of vegetation, against the rain and the heat, where the last heavily fortified police station marked the farthest reach of central and state authority in a heave of tangled razor wire and bunkers. Then it stopped.

After the end of the road? Then you were into another world, undeveloped India, Naxalite territory: a land of parallel authority, communism, people's courts, armed cadres, and IEDs.

The Naxalites took their name from Naxalbari, a village in West Bengal where in May 1967 an abortive peasant uprising against landowners took place and a police inspector died in a hail of arrows. The bloodshed christened an amorphous, fragmented movement, loosely inspired by the

Maoist model of agrarian revolution. From then on, Maoist militants were known as Naxalites.

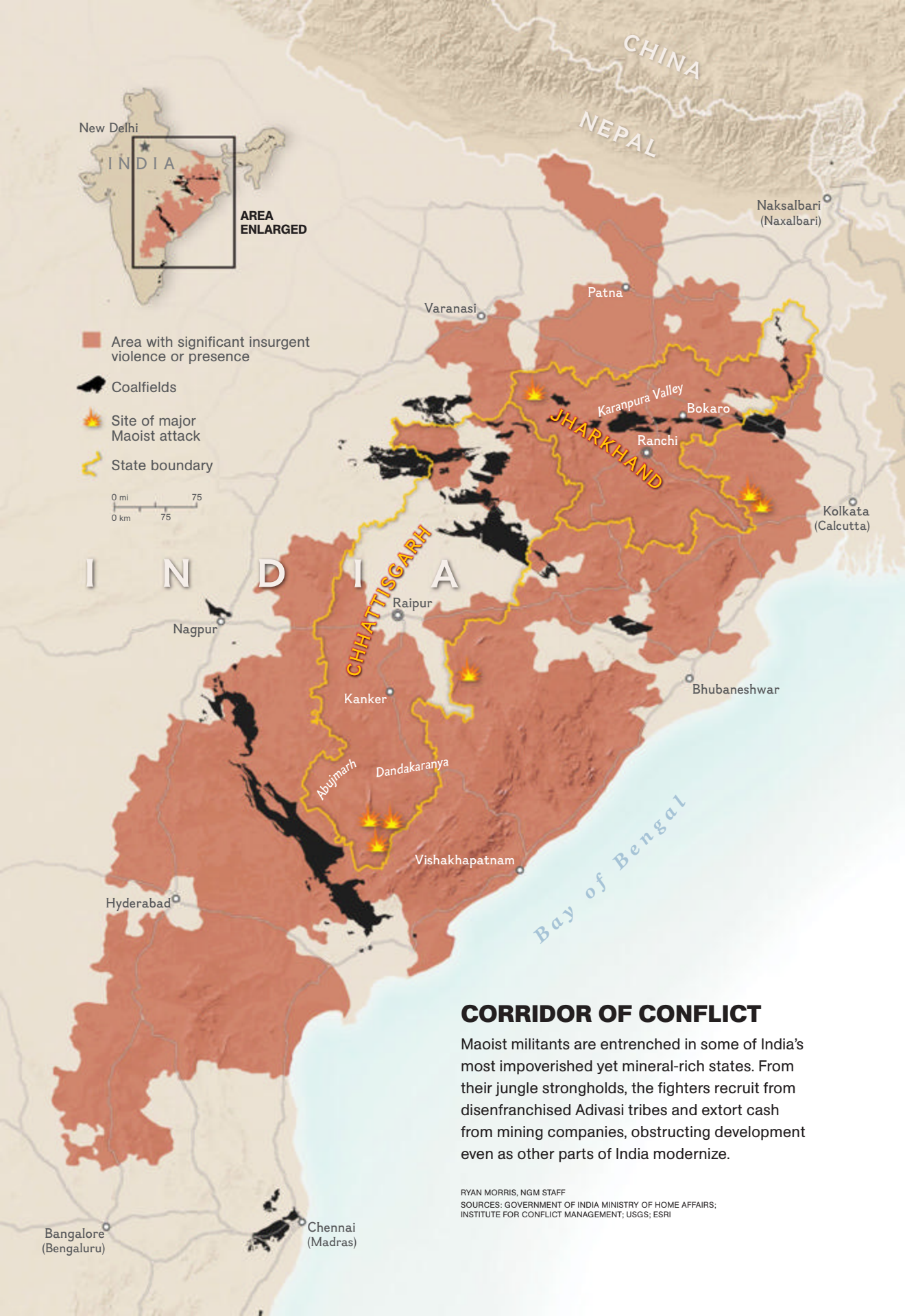
Their sanctuary became the 35,600-square-mile forest of Dandakaranya, which loosely translates from Sanskrit as Jungle of Punishment. Straddling parts of several states, including Chhattisgarh and Andhra Pradesh, Dandakaranya afforded the Naxalites a citadel of sorts: Abujmarh, a jungle within a jungle, one of the last of India's uncharted territories. Beneath the area's dense canopy of vegetation, rugged hills and valleys are bisected by streams that rage as torrents during the rainy season, forbidding terrain for any unwelcome stranger.

Death came in many ways in that jungle. The Naxalites killed police and paramilitaries with roadside bombs and ambushes. The police killed the Naxalites in "encounters," the vernacular encompassing both firefights and targeted killings. Suspected government informers were tried in people's courts and killed with axes or knives, leading to a surge in the homicide rate not reflected in the conflict's official casualty count of more than 12,000 dead across two decades.

The first Maoists, middle-class communist radicals from the state of Andhra Pradesh, arrived in Abujmarh in 1989, fleeing a crackdown by local authorities. The movement might have died out altogether then, its ideology withering in the sweaty heat. Yet Abujmarh proved an elixir to the Maoist revolutionaries. Here in the depths of the jungle, they found a natural new constituency among the Adivasi tribes.

The term Adivasi means "aboriginal" or "original settler" in Sanskrit, and the Adivasis are officially classified as members of Scheduled Tribes, defined by the Indian Constitution as indigenous groups given some form of recognition under national legislation. They number 84 million—6.8 percent of India's population—and are concentrated most heavily in and around Dandakaranya.

It would be simplistic to describe the Naxalite movement as solely Adivasi. Its organization's cadres include not just members of India's Scheduled Tribes but also middle-class students, as well as Dalits—the so-called Untouchables of









Policemen in Chhattisgarh are put through a grueling commando course at the Counter Terrorism and Jungle Warfare College, in Kanker.



the lowest caste—and a large number of fighters from the country's socially disadvantaged, described in the constitution as Backward Classes.

Unworldly and vulnerable, the Adivasis in Abujmarh proved natural hosts to the fugitives among them, and after years of exposure to Maoist ideology, many became Naxalite recruits.

It was hardly surprising in a nation where nearly 180 million people survived on less than two dollars a day—and where a round of drinks among the urban elite in a Delhi bar could exceed a farmer's monthly wages several times over—that militant communism would thrive in neglected areas beyond the writ of local authority. The glitz and glamour of central business districts were a universe away from vast, impoverished tracts of rural India.

What made the Naxalite insurgency so peculiarly ironic, however, and gave it such an impact on the country's future was that its epicenter was in the very heart of India's immense mineral wealth. This is the natural inheritance so central to Prime Minister Narendra Modi's strategy to regenerate India's moribund economy and provide electricity to the one-third of the country's households—some 300 million people—that still live in the dark.

It was no coincidence that the cockpit of the war was in Jharkhand and Chhattisgarh. Those states are among the country's richest in terms of mineral wealth, containing more than 40 percent of India's coal reserves. Their subterranean treasure trove also includes trillions of dollars' worth of iron ore, limestone, dolomite, and bauxite reserves. The coal fuels the power plants that light up India's distant metropolises. The steel makes the modern buildings, the gleaming tech complexes, the vehicles and engineering projects so integral to Modi's vision.

Yet these two states have the worst record of Naxalite violence and some of the worst poverty rates in India. In 2010 one multidimensional analysis of poverty, drawn up with support from the United Nations Development Programme, said that eight Indian states, including Jharkhand and Chhattisgarh, accounted for more poor people than the 26 poorest African nations combined.

Fighters from a Maoist splinter group, the TPC, patrol a village in Jharkhand, looking for former allies. Feuds and extortion rackets have fragmented the Naxalites during the insurgency.



Rather than reduce the imbalance between rich and poor, mineral wealth has exacerbated the divide, adding pollution, violence, and displacement to the daily struggle of those whose livelihood is locked in the land. The Karanpura Valley of northern Jharkhand epitomizes the situation. Once famous for its tigers and a major migration route of elephants, the area today is home to open coal pits, where massive quantities of the carbon rock are mined. Originally mapped in the 1800s, coalfields there were acquired by Central Coalfields Limited (CCL), a local subsidiary of state-owned Coal India Limited (CIL), in the mid-1980s.

Across the decades, CCL had offered all sorts of compensation to the locals—jobs, money, resettlement, alternative housing—in return for their land and their departure. Many accepted



payment, gave up their land, and left. For others, farming people whose sense of soul and livelihood was inextricably linked to the soil, the lure of money held little attraction. Pockets of them hung on, as their dust-covered houses crumbled and cracked around them with the shock waves of pit blasting hammering up through the soles of their feet and smearing the horizon with a haze of smoke.

The Naxalites were already long established in the area, feeding off the sense of division and abandonment. A month before my first visit there, a large group of armed Maoists had attacked the valley's Ashoka mine, burning dump trucks and company jeeps before being driven off in a running gun battle with local police.

"Our land is everything to us," explained a young local activist in the village of Henjda,

as another pit blast rent the air. "Seventy-five percent of our village are refusing to give up their land to CCL. They offer us money as compensation. They offer us jobs in the coal-fields: one job for every two acres of land. But none of it is enough. Money goes. Jobs end. Besides, some families have nine people depending on ten acres of farmland. So we aren't moving."

As in so many other rural coal-mining areas, local communities have been divided between those clinging to their homes and resisting the encroachment of the mines and those who signed on as land agents for CCL, tasked with persuading other people to sell their land. It was easy for the Maoists to exploit the situation. Fights already had broken out between the split communities, and the graffiti



on the cracked walls boded further ill.

“Agents of CCL, take our land and give your heads to us,” one ominous threat read. Many moved just to escape the poisoned relationships within their villages. When I went back to Jharkhand two years later and asked about the young activist I’d met, I learned that he had abandoned his activism, worn out by death threats and police harassment. His friends said that he had a new job too—with CCL.

THE MAOISTS WERE NO slouches at exploiting minerals either. As my travels lengthened through Chhattisgarh and Jharkhand, one thing became clear: Mining and mineral exploitation

**“We’re not the enemy of mining,” Comrade Ranjit said, smiling. “It can be our friend.”**

had antagonized the Adivasis and the disadvantaged rural poor, making them aware of being the have-nots in a land of potential have-a-lots. But the Naxalites did nothing to oppose mineral exploitation. They thrived on it.

Comrade Manas had never tried to duck the subject when I quizzed him on Naxalite mining policy. He told me that most Maoist units, on hearing that mineral surveys were taking place, far from seeking to attack and drive off mining companies in defense of local land rights, asked a simple question: “What will be paid to the party as taxes?”

Revenue was critical to the Naxalites’ survival. Like any insurgency, theirs needed funds, and the potential levy on mining—alongside the protection rackets, kickbacks, and access to industrial explosives that came with it—far

exceeded anything the Maoists’ annual tax on *tendu* leaves (used since the 17th century to roll cigarettes) or rice could come up with. When mines were attacked, it was often only because their owners had not paid the protection money or had held back giving the Naxalites a cut of the profits.

“In many parts of India today, Maoism is not ideology driven but levy driven,” warned Jairam Ramesh, India’s minister for rural affairs before his National Congress party (INC) government fell to Modi’s Bharatiya Janata Party (BJP) in the 2014 elections. Ramesh was so concerned about the symbiosis between the Naxalites and the mining industry that he had publicly demanded a moratorium on all mining in the areas worst affected by the insurgents.

“Where there is mining, there is Maoism, because where there is mining, there is more revenue, and where there is more revenue, there is more extortion,” he added. “Some of the best-known names in Indian industry are running businesses in the Maoist areas by paying off the Maoists. I don’t want to name names, but these are the biggest names in Indian industry.”

I was allowed a glimpse of the operation firsthand one October day in Jharkhand. A series of coded calls led to a meeting with a stranger in a rural marketplace. In turn, he guided me to a deserted stretch of track beside the jungle—the rendezvous point for a Naxalite commander, alias Comrade Ranjit, who in addition to his many other tasks oversaw an insurgent-controlled coking plant.

The plant lay in open fields beside the jungle just a few miles from Jharkhand’s thermal power station at Bokaro, built in 1986.

The coking operation he next showed me was entirely professional—and entirely Naxalite run. The plant had been built without a license and relied on local coal mined illegally by local villagers, who chipped away in a multitude of nearby mines. The Naxalites protected the site and made money from it. The police took a cut of the profits too, or so Comrade Ranjit insisted as we walked around the plant. He claimed that the Naxalites paid officials a hundred thousand

rupees (about \$2,000) a month to stay away from the site. He also explained a simple system of bribery involving corrupt officials who were paid a fee to issue documents legitimizing each 25-ton truckload of Naxalite coke so that it could flow into the legal convoy chain. For their part, the Naxalites took the equivalent of a thousand dollars a day in levies from the operation.

"We're not the enemy of mining," Comrade Ranjit said, smiling, puzzled at my frown of dim comprehension. "It can be our friend."

Multiply the figure of a thousand dollars a day across the thousands of illegal coking plants and coal mines that lie within Naxalite areas. Add to it what top-ranking mining companies pay the Maoists each year for protection—an amount described conservatively by Jairam Ramesh as "millions and millions" of dollars. Mix into that equation known mineral reserves, the hungers of globalized industry, social grievances, and the schisms in a developing society caused by ill-distributed coal-boom profits, and the Naxalites stop looking like museum-piece ideological artifacts and start looking more like an immensely well funded and complex insurgency that links European economies with a roadside IED planted for a police vehicle approaching an Adivasi village in Chhattisgarh. They look like a phenomenon of the globalized present rather than the Maoist past.

If the jungle gave the Naxalites sanctuary and mineral wealth gave them money, it was land acquisition and displacement that gave them a well of recruits and formed the forefront of the government's response to the insurgency.

Ever since it became law in 1894, the Land Acquisition Act—an archaic piece of colonial legislation created expressly to allow the government to seize land for public purpose under the principle of eminent domain—had been the source of bitter contention throughout India. It had displaced millions of people from their homes for mining and hydroelectricity, road and rail projects. By the time the act was overhauled in 2014 to include meaningful reparation and rehabilitation clauses for the dispossessed, the damage had been done. In the years

since India's independence alone, the right of eminent domain had been used to displace an estimated 60 million Indians, including about 24 million Adivasis.

The hardship has been especially severe for the Adivasis, many of whom have not been properly resettled. Given that 90 percent of India's coal, more than 50 percent of mineral reserves, and most of the desirable hydropower dam sites are in Adivasi areas, land acquisition has thus become the de facto fault line between the needs of traditional hunter-gatherer societies and the requirements of a rapidly industrializing economy with a ravenous appetite for better infrastructure.

Yet today, even the new act of 2014 is in difficulties. Originally drafted by Ramesh and passed by the outgoing INC administration, it established a benchmark of compensation and resettlement among the displaced, intending to pull the teeth of their anger and undermine the Naxalites. Yet under pressure from industry and mining interests, Modi's BJP government is already eyeing the act as the target of possible revision, and land rights seem set to remain a source of anger and dispute for the indefinite future.

HOWEVER MUCH they drew strength from legitimate social grievance, there was still no doubting the terror the Naxalites could inspire. The brutality of their war revealed itself one spring morning in Chhattisgarh. I had driven deep into the south of the state near the town of Bijapur, following up on a vague police report about a Maoist attack on an Adivasi village. Stopping in Kutru, a village in the foothills of Abujmarh, I stared out into the press of jungle toward the point where the road, already not much more than a rutted track, finally thinned and divided, petering out into a half dozen trails before vanishing into a kaleidoscope of smashing green.

It may have looked beautiful from the outside, but few Adivasi adults in that forest had a balanced diet, and malnutrition was rife among their children. Anemia and pulmonary tuberculosis were common, and in the more remote areas, infant mortality could take three out of five





Nine-year-old Malti Telam, whose father was killed in the violence, combs a friend's hair at an orphanage in Kutru, Chhattisgarh. Every child here has lost at least one parent to the insurgency.









children. Almost every statistic about the Adivasis placed them at the bottom of India's social scale. They had the lowest life expectancy and literacy rate. Seventy-five percent lived below the official poverty line. Every year, monsoons brought death to thousands, from diseases such as gastroenteritis and malaria. Polio and blindness rates were high. The potential benefits of development and a fair distribution of mineral wealth should have brought immense improvements to the quality of life—had they not been so catastrophically mismanaged.

Put aside the Adivasis' sense of inequality, even abandonment, by the state, and it was clear that few of them wanted their traditional hunter-gatherer life, an existence without an alphabet, schools, electricity, roads, in which many babies and mothers died in childbirth

and the village shaman treated every affliction, from cerebral malaria to cholera. The Naxalites offered them no better alternative, only a hazy notion of protection and an archaic ideology long abandoned by the rest of the world.

As I looked at that green landscape in the warm early morning, it seemed impossible to imagine what harm lay ahead. Neither a whisper of man nor a hint of malice came from those crowded trees, the jostle of mahua leaves, tamarind, and kusum. Instead the air vibrated gently with the thrum of insects and the hoots of unseen birds.

Then, from among the low tribal huts on one side of the road's end, the sound of a woman's weeping rent the stillness. Her sobbing lasted barely a minute, yet it carried an inconsolable grief. The Adivasis I encountered were supremely self-possessed and enduring, and it was rare to



Adivasi bride Rani Kumari—her head daubed with turmeric paste for purification and good fortune—is 15 years old. In Jharkhand nearly two-thirds of girls are married by age 18.

see them express any such extreme emotion.

The village men brought her over to me. Sarita was her name. Her face was waxen with sadness and shock, but she was proud and stared me directly in the face when she spoke. She was just 19, an Adivasi girl from the Maria tribe. She wore a light tribal dress and carried herself with the same straight-backed, sure-footed poise I always saw in the Adivasi villages.

She had arrived in Kutru the previous night along with 30 others, most of them extended family members. They lived in Kerpe, a village deeper in the jungle, but had fled their home as fugitives from a Maoist ultimatum. The Naxalites had emerged from the jungle and occupied their village the previous week, Sarita told me, cutting it off from the outside world. She said there were more than a hundred fighters in all,

men and women dressed in olive fatigues and heavily armed, and that they were commanded by a large woman known as Ranjita.

The Naxalite armed cadres usually appeared in the area in April, emerging from Abujmarh and traveling from village to village along the jungle fringes extracting a levy from the tribes on the sale of their tendu leaves. On this occasion, though, the Maoists had more than levy on their minds. Sarita's relatives had made a fateful mistake. An educated family, three months earlier they had collected signatures from locals as part of a petition to the state authorities requesting that a police station be established in Kerpe. The attendant benefits of a police presence in the village included a road.

The militants seized Sarita's father, her brother, and a cousin from their home. Next Ranjita and her cadres summoned the village to witness a Jan Adalat, today's incarnation of the infamous People's Courts established by Mao in the 1950s as a way for Chinese peasants to put landlords on trial.

First Ranjita read out the charges against Sarita's family. Next three alleged government collaborators, bound and blindfolded, were beaten with clubs and fists before the silent crowd. "Then it suddenly finished," Sarita said. "Ranjita addressed us one last time. She told the village that anyone with relatives in the police or local government had one week to leave their homes or be killed. Then she walked up to me and said I would find my father and brother 'sleeping' on the path home. The Naxalites made us chant Maoist slogans a few times, and then they disappeared."

Sarita did find her father and brother on the trail home. They lay beside her abducted cousin. The men's hands were tied, and they had been beaten to death with the flat edge of axheads. Her brother's eyelids had been cut away with a knife.

I left her standing at a point near where the jungle fell upon the edge of the village. She had stopped crying by then and looked about with the cool, practical regard of a newly anointed refugee assessing the rules of necessity, weighing the prospects of life on each side of the road's end. □







#### SOUTH DAKOTA

Mountain pine beetles are ravaging western forests, including those around Mount Rushmore. Gray pines are dead and bare; rust-colored trees died more recently and still cling to their needles. A quarter of Black Hills forests have been affected. Will the beetles spread across the continent?



# The Bug That's Eating The Woods

*A warming climate allowed pine beetles to ravage the West. Now they're spreading east across Canada.*





#### ALBERTA, CANADA

Since 2004 foresters in Alberta have cut more than a million infested trees, hoping to slow the beetle's eastward march. Most felled trees are burned, like these near Grande Prairie.

#### MONTANA

On a ranch near Seeley Lake (left), a worker sprays a ponderosa pine with insecticide to fend off beetles. But spraying whole forests every year would be too costly and polluting.



*By Hillary Rosner*  
*Photographs by Peter Essick*



NE CHILLY MORNING in  
October 2013, Diana

Six parked her white Subaru at the edge of a pine forest in southwestern Montana's Big Hole Valley. Beneath snow-tipped peaks, lodgepole pines in four different colors draped the hillside—a time line of carnage. The gray ones, now just trunks and branches, had died in 2009. Light red trees, still holding needles, had succumbed in 2011. Darker, auburn trees had perished in 2012. Even the seemingly healthy green trees, said Six, a ponytailed, bodybuilding, beer-brewing entomologist at the University of Montana, were not what they seemed. Roughly a quarter of them were already doomed.

Six zipped her jacket and ambled into the woods with an ax. She stopped at a mixed stand of emerald and burnt-orange lodgepoles. With the ax blade, she gently peeled a strip of bark from a green tree, exposing the pale wood beneath. There, wedged into narrow channels carved into the wood, were tiny black larvae the size of sesame seeds. They were dead, done in by an early hard frost—but it had come too late to save the lodgepole. Though the tree appeared to be thriving, its phloem, the fibrous layer under the bark that transports nutrients, was dry and brown.

Six moved to the next tree, another seemingly healthy one. Its phloem was greenish pink and pliant, clearly still hydrated. But it was laced with

the same telltale channels. From their size and the lack of larvae, Six concluded that this tree had been invaded as recently as a week earlier. As she peeled back the bark with her ax, she accidentally squished a small black beetle.

Across western North America, in millions of acres of pine forest, the story is the same. Drive through parts of Colorado, and you'll encounter entire mountainsides painted with rust. From valley bottoms all the way to the tree line, nearly every single pine has been killed by an enemy smaller than a thumbtack: the mountain pine beetle. Tour British Columbia, and the scale of destruction is even more appalling. More than 44 million acres of pine trees there, an area the size of Missouri, have been attacked to varying degrees over the past 15 years.

Nature is always changing. But the mountain pine beetle is a troubling omen. It shows that global warming can push even native species to go rogue. At some point the epidemic will run its course, leaving a wake of ghost forests and altered ecosystems. "We need to see this as a harbinger of what's to come," Six says. "We're going to see one ecosystem after another begin to tip."

UNLIKE OTHER ORGANISMS that have been ravaging the American landscape—Asian carp, kudzu—the mountain pine beetle isn't an immigrant. It's native to western pine forests, especially lodgepole and ponderosa forests,



#### ALBERTA

To learn how far pine beetles can fly, Maya Evenden of the University of Alberta tethers them to a “flight mill” and flies them in circles. Their average distance in her lab: one to four miles, depending on their age. The record: 15 miles.

where it normally lives in relatively small numbers, killing a tree or two here and there. It's been normal too for the beetle's population to boom every now and then, and for it to kill large swaths of forest. But mainly in a single region—not across half a continent.

The scale of the current epidemic is unprecedented. Since the 1990s more than 60 million acres of forest, from northern New Mexico through British Columbia, have suffered die-offs. By the time the outbreak in British Columbia peters out, some 60 percent of the mature pines in the province may be dead. That's a billion cubic meters of wood.

The trees aren't the only casualties. A forest die-off disrupts everything, from food webs to local economies. In British Columbia timber-mill towns are cash-strapped; in Yellowstone National Park bears and birds have lost a rich source of nutrition. Falling trees have closed campgrounds, crushed cars, and sparked wildfires by toppling power lines. Formerly secluded

forest homes now have views of the neighbors. With nothing to anchor it, soil washes away.

For its current good fortune, the mountain pine beetle can thank us. To start with, we've spent the past century eliminating forest fires—thereby turning the woods into beetle buffets. When the crisis began, British Columbia's forests were packed with three times as many mature pines as there would have been had they been allowed to burn naturally. Like mountain pine beetles, fire is native to western forests, and it's as important as rain to their health. It nourishes soil, spreads seeds, creates openings for sunlight, ensures habitat for all sorts of creatures.

According to Allan Carroll, an insect ecologist at the University of British Columbia who has been studying the beetles since he was an undergraduate in the late 1980s, only 17 percent

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*Hillary Rosner teaches journalism at Syracuse University; this is her first feature for the magazine. Photographer Peter Essick's first appeared in 1986.*





PINE BEETLE, ACTUAL SIZE

# Death by a Thousand Bites

For centuries the relationship was mutually beneficial: Pine beetles culled older, weaker trees, producing new beetles but also a healthier forest. Climate change, with its warmer, drier conditions, has upset that balance, leaving even healthy trees vulnerable to attack.

## FIRST WEEK

### Selection and Invasion

The cycle begins in summer, when a lone female beetle bores into a tree's bark and releases a pheromone that attracts hundreds of other beetles.



The tree tries to suffocate the insects by secreting resin into the beetles' boreholes.

## SECOND WEEK

### Burrowing and Egg Laying

Beetles dig galleries under the bark, depositing eggs and blue fungi to feed the next generation. The galleries block nutrient flow in the tree's phloem layer.



Sixty to eighty eggs are laid in each gallery.

Phloem layer

## THIRD WEEK TO 4 MONTHS

### Hatching and Feeding

Larvae hatch and chew side galleries, feeding on the phloem and the fungi.



The larvae develop cold resistance in time for winter.

- ◀ The tree remains green for months after beetles have fatally mauled it.

## 5 TO 12 MONTHS

### Overwintering and Dispersal

The beetle larvae lie dormant until spring, when they'll turn into pupae, then adults. The new brood feeds on fungal spores before dispersing to another tree.



Pupal stage



Fungi-carrying new adult

- ◀ Needles turn yellow in the dry heat of summer.

## 13 TO 24 MONTHS

### Red Means Dead

The beetles are long gone, and the drying tree turns red. Finally it loses most of its needles and becomes gray.



JOHN TOMANIO, NGM STAFF;  
SHELLEY SPERRY  
ART: SAMANTHA WELKER  
SOURCE: DIANA SIX,  
UNIVERSITY OF MONTANA

of British Columbia's lodgepole pine forests were ripe for a beetle attack a century ago. By the mid-1990s that number had risen to more than 50 percent. Yet even that epic surge in vulnerable mature trees wouldn't by itself have killed whole mountainsides across ten states and two Canadian provinces. That vulnerability intensified the epidemic—but a change in climate was required to kick it off. The beetle has us to thank too for warming the whole planet with our carbon dioxide emissions.

Rising temperatures and drought have stressed trees, leaving them unable to fight an invasion. Warmer weather also has boosted the beetles' population and greatly expanded their range. They're flourishing farther north and at higher elevations, invading pine trees, such as jack pine and whitebark, that had rarely seen them until a few years ago. Because these trees aren't as good at defending themselves, a smaller band of beetles can overwhelm them. Three-quarters of the mature whitebark pines in Yellowstone National Park are now dead—a blow to grizzly bears, which eat the seeds in autumn, and to Clark's nutcrackers, which cache the seeds for winter.

In 2008 Carroll and other researchers produced a report for the Canadian government, concluding that the risk of the mountain pine beetle infesting jack pines in the boreal forest—which stretches right across Canada, covering a quarter of the country—was small but significant. But the beetle is already in jack pines. It has now colonized Alberta all the way east to Saskatchewan and north to the Yukon and Northwest Territories. Unlike lodgepoles, jack pines live as far east as Nova Scotia and down into the upper Midwest and New England.

"Will the beetle move across the continent?" asks Carroll. Colleagues call him Dr. Doom—if he's meeting with your local officials, it's a good sign your forests are toast. He answers his own question: "Yes."

ATOP CARROLL'S DESK at the University of British Columbia in Vancouver, a motorcycle helmet and jacket sit at the ready for his semiweekly commute home to Vancouver Island—a trip

that takes several hours and winds past thriving forests of Douglas firs. Carroll often takes back roads to spend more time amid robust trees. Under his desk is a white bucket containing a lodgepole pine log. Inside the log a female mountain pine beetle—Carroll calls her his office mate—has laid her eggs.

Carroll's office mate is a *Dendroctonus ponderosae*, one of about 6,000 species of bark beetles, including 500 that live in the U.S. and Canada. Most bark beetles lay eggs under the bark of trees that are already dead or dying. Only a few species burrow into healthy trees, and of those, most go in as a lone pair, posing no threat. Even the few species that do kill trees tend to target highly stressed ones. The mountain pine beetle is the bad bug of the bunch. Given the right conditions, it can ravage one healthy tree after another.

When a female mountain pine beetle like the one in the bucket lands on a tree, she first has to decide whether it's a decent place to raise a family. To do this, she'll chew into the bark and taste the chemicals. If the tree meets her standards, she'll continue burrowing, severing ducts that contain resin—the tree's first line of defense. Ideally for the tree, the resin will simply flush the beetle out.

But evolution is all about one-upmanship. And in a particularly elegant flourish, the beetle has evolved to ingest the resin—if she can survive swimming through the syrupy river—and convert it into a pheromone, a chemical that sends a message to other beetles. By releasing this pheromone into the air, the beetle signals that she's found a great place to congregate. Other beetles, male and female, gather. If there are enough of them, a mass assault ensues.

The tree doesn't give up easily. As soon as the burrowing beetles reach living cells, the cells commit suicide. As they die, they rupture, releasing a substance that's supertoxic and beetle annihilating. If there aren't a lot of beetles, says Carroll, "generally the tree wins." But if the beetles invade with an army, not just a few scraggly mercenaries, they overwhelm the tree. Depending on the tree's condition, it can take many









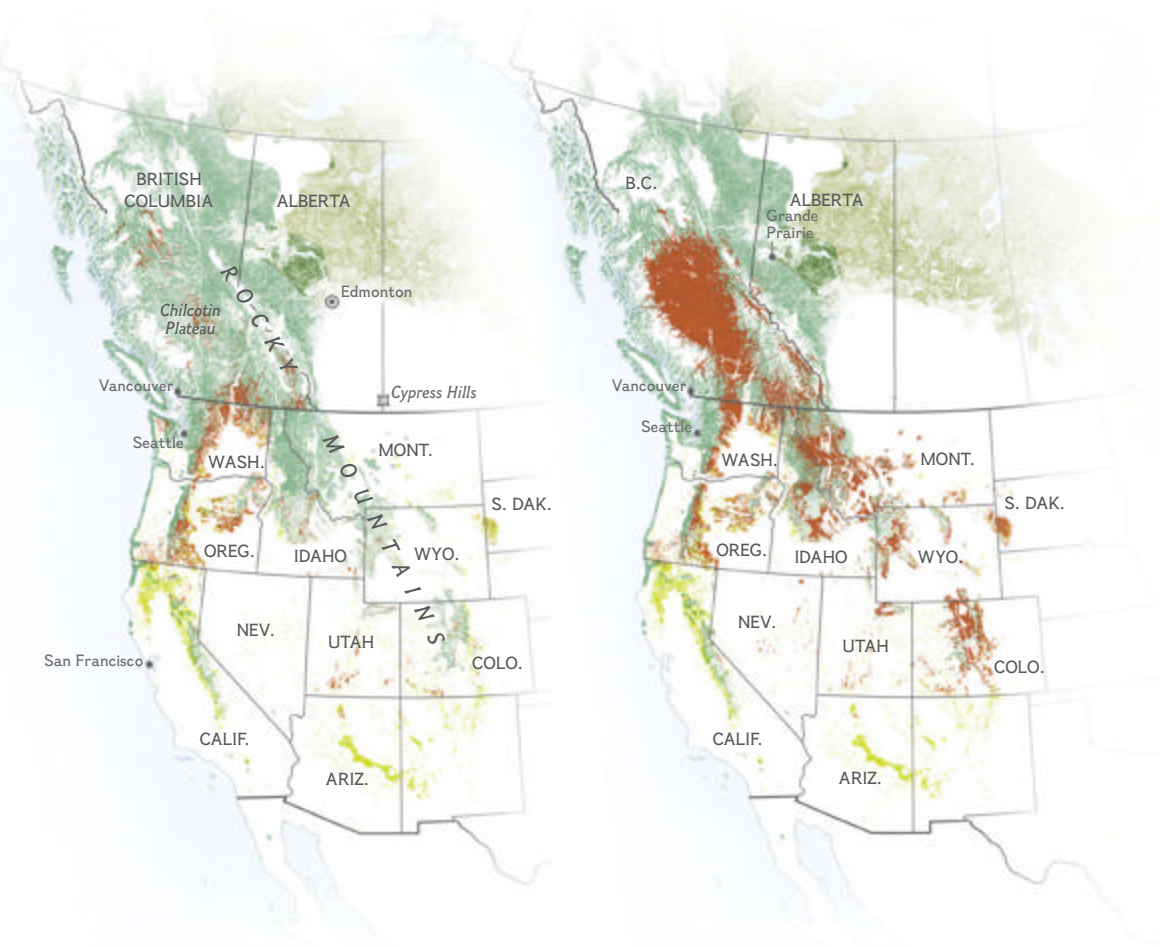
#### COLORADO

Spruce beetles and fire have killed almost every tree near Wolf Creek Pass. The pine beetle epidemic has peaked in Colorado, but attacks by spruce beetles—which also burrow through bark—are still on the rise.



# Chronology of an Epidemic

Historically the mountain pine beetle's primary host has been lodgepole pine. In the north, where lodgepoles dominate the landscape, cold temperatures helped keep beetle populations in check; down south the insects had far fewer trees to infest. With forests increasingly warmed by climate change, the beetles are thriving in once inhospitable areas, attacking species of pine they rarely touched before—and drastically altering the landscape.



## THE BEETLE AND ITS HOSTS

- Mountain pine beetle occurrence
- Lodgepole pine range
- Jack pine range
- Other pine species

0 mi 400  
0 km 400

1990-1996

### Prelude to Disaster

A potential epidemic in the mid-1980s was averted by two particularly cold winters in a row. But by the mid-1990s a combination of forestry policies, warmer winters, and dry summers had helped beetle numbers rise dramatically. Infestations erupted in pockets across drought-stricken British Columbia, Washington, and Oregon, sowing the seeds of an epidemic.

1997-2006

### The Epidemic Begins

Beetle populations swelled to unprecedented numbers as their range expanded north and east. By 2006 beetles had crossed the Canadian Rockies and were in the area around Grande Prairie, Alberta. By 2007 the epidemic in British Columbia was slowing, as the beetles ran out of trees to attack. But from Montana to Colorado it was nearing its peak.



Northern Alberta, where jack and lodgepole pines both thrive, is now the front line in the beetle battle. Alberta's aggressive cutting and burning of trees may slow the beetle's eastward spread.

Few species of pine are immune to the mountain pine beetle. Some scientists fear that winds or infested wood might even spread it to the white, loblolly, and longleaf pines of the Southeast.

2007-2013

**Into the Jack Pine**

The beetles advanced into formerly inhospitable zones, where winter temperatures are no longer reliably cold enough to kill them. They also colonized jack pines, a species found across Canada's boreal forest. If the beetles can sustain a population there, they could eventually spread east across the country and down into the Midwest and New England.

MARTIN GAMACHE, NGM STAFF; SHELLEY SPERRY  
SOURCES: CANADIAN FOREST SERVICE; BARBARA BENTZ AND JEANINE PASCHKE, U.S. FOREST SERVICE; AARON MCGILL, ALBERTA ENVIRONMENT AND SUSTAINABLE RESOURCE DEVELOPMENT; TIM EBATA, BRITISH COLUMBIA MLNRO; ALLAN CARROLL, UNIVERSITY OF BRITISH COLUMBIA; BRIAN AUKEMA, UNIVERSITY OF MINNESOTA



thousands or just a few hundred beetles to kill it.

The drought and warmer temperatures that have struck western forests in recent years have helped the beetles in two ways: by stressing the trees so much that they succumb more readily and by giving the beetles more time to attack them. Beetles in Montana, says Six, used to fly from one tree to another mainly during two weeks in July. But now, as that infested tree in the Big Hole Valley shows, the flying season lasts into October. That means the beetles have additional time to reproduce—even as the extreme cold snaps of fall and spring, which helped keep populations in check, have become rare.

There's an eerie wisdom in a beetle mob. Sparsely distributed beetles besiege small trees; denser groups go for larger quarry. They seem to attack a large tree only when they know there are enough of them to take it. How does the first beetle know? Carroll and his graduate student Jordan Burke suspect it's the pheromone. A burrowing beetle releases it to call for help, but the amount that's in the air already tells her whether help is available and it's safe to lay her eggs. The beetle in Carroll's office is part of an experiment testing that hypothesis.

In any case, the cycle feeds on itself. The bigger the tree, the more beetle babies a beetle mom produces. More beetles mean more mass attacks on bigger, healthier trees. Once there are enough beetles to blast large trees, large swaths of forest are essentially doomed.

IN 2013 SCIENTISTS at the University of British Columbia sequenced the mountain pine beetle's genome, making it only the second of more than 400,000 beetle species to bear that distinction. (The first was the red flour beetle, which infests stored grains.) But Joerg Bohlmann, the plant biochemist who oversaw the sequencing effort, doesn't think a biotechnical fix to the pine beetle epidemic is imminent.

"We have to be extremely careful we don't promise things that are not realistic," he says. Pesticides can save a few individual trees but not a forest; they're too expensive, and they'd kill all sorts of other organisms. Breeding beetle-resistant

trees would take decades, even with modern genetics. And even then the beetles might rapidly adapt and break through the resistance.

For the moment most research, from the genome work to the beetle in Carroll's bucket, is aimed at simply improving our ability to predict insect outbreaks. "No one can give you a certain answer about where the bark beetle will be in five years," says Bohlmann. "That is the biggest issue." If you can get to a forest soon enough, when beetle populations are still relatively small, you may control the infestation. At least that's the theory that's being tested in Alberta, which has become the front line in the battle

***To save a forest, you  
have to cut a lot of trees—  
to ensure the beetles  
have nowhere else to go.***

to stop the beetle's march across the continent.

In many parts of British Columbia and the western United States the infestation is slowing on its own—in some places because there aren't many trees left to kill. But in Alberta it began more recently. Alberta has about 15 million acres of pines, far fewer than British Columbia, but they're in vitally important areas, at the sources of mountain rivers that feed the prairies and cities below. If those forests are devastated, the unshaded snow will melt faster, and rivers will crest earlier—before the dry season, when people and ecosystems need the water most.

To save a forest, you have to cut a lot of trees; the only way to stall the beetles is to ensure that they have nowhere else to go. Alberta's long-term strategy is to log or burn most patches of forest that are dominated by mature pine trees and thus highly susceptible to the beetles. Its short-term strategy is to fight the beetle tree by tree. In the past decade it has spent more than \$320 million (U.S.) on beetle management.



#### IDAHO

A chinook salmon spawns in the Yankee Fork of the Salmon River, where dead lodgepole pines line the banks. The trees are vital to the threatened salmon: By slowing snowmelt, they keep streams cool into spring and limit excess silt.

The aim, says Erica Samis, a senior forest manager at Alberta's Ministry of Environment and Sustainable Resource Development, is to limit the beetle's spread along the eastern front of the Rocky Mountains and east into the boreal forest. Foresters hand-fell any cluster of three or more trees that are green but actively infested—sometimes a whole stand—if there are enough vulnerable trees within three miles. They burn or chip the trees to kill the beetles. In the area around Grande Prairie, where the beetles had never been seen until winds carried them over the Rockies in 2006, foresters have cut down 200,000 trees just since 2012.

Carroll likens beetle management to paying down a large balance on a credit card. "What you have to do is hit more of the beetle than what is growing annually," he says. "You've got to get past the interest into the principal. But when the population gets so big that you can't even get partway through the interest, you're hosed."

So far Alberta has managed, year by year, to

make a dent in the principal—at least in most areas. Parts of the province have been designated "holding zones," where the government is just trying to keep beetle numbers steady. Other parts have been deemed a lost cause: There are just too many beetles. If foresters can't remove at least 80 percent of infested trees, they figure, there's no point in doing anything. As Samis puts it, "You're peeing into the wind."

WHAT LIES AHEAD IN THE BATTLE for North American forests? Alberta is burning its felled dead trees in huge piles set alight during the soggy weeks of early spring. If you were to slice into one of those logs, you'd see a lovely blue stain seeping through the yellow wood. It's a telltale sign of a tree that was killed by mountain pine beetles, and it has generated a cottage industry in siding, cabinets, and furniture made with the blue-toned lumber. Throughout the western U.S. you'll find "beetle kill" pine adorning homes, stores, and restaurants. My house in









## WYOMING

A camera trap near Yellowstone National Park catches a grizzly bear stealing whitebark pine nuts from a squirrel's cache. The nuts are an important food for the bears, a threatened species.

DREW RUSH





#### SOUTH DAKOTA

A beetle effigy made with beetle-kill wood warms a joyful crowd at a winter festival in Custer. "Dealing with the beetle is a running battle," says forester Frank Carroll. "It's the one time of the year we get to feel we have the upper hand."

Colorado has a ceiling built of beetle-kill planks.

In Missoula, Montana, Ryan Palma runs Sustainable Lumber Company, which sells high-end, handcrafted flooring, doors, and paneling made from blue-stained ponderosa pines, many 100 to 400 years old. He harvests only trees that have been dead at least two years, so that all the beetles are gone, and he dries the wood slowly in a large kiln that's fueled by scrap beetle kill. The stain "kicks the wood into a lower grade," says Palma, "so sawmills don't want it." But a luxury market is growing, mostly out of state. Musician Jack Johnson has a beetle-kill guitar; Al Gore owns a blue-stained ukulele.

The blue hue is caused by a fungus, one of two that the mountain pine beetle carts around in a "fungi suitcase" in its exoskeleton. (The beetles also carry yeasts, and for years Six used one variety to home brew a beer she called Six-Legged Ale.) When beetles bore into a tree, the fungi slip out of the suitcases and grow alongside the larvae, providing them with nitrogen-rich

food. "The beetles can't survive on the wood," says Six. "It's pretty much junk food. The fungi act like nutritional supplements, and that's what allows the beetles to do what they do."

One of the two fungi thrives in cool temperatures; the other likes things warm. Their populations in the beetles shift with temperature. Six's lab created models to see what might happen to the fungi as the planet warms. "If we warm things up a degree," she says, "what appears to be a very symbiotic, fine-tuned system begins to fall apart." Over the course of a century the cool-loving fungus disappears.

That's a small source of hope. The cool-loving fungus is the superior source of nitrogen; it enables the beetles to produce one-third more offspring, which can make all the difference to a forest. Six says the cool fungus is already vanishing in warmer parts of Montana; in some low-elevation ponderosa forests, less than one percent of the beetles now carry it. Global warming has been letting the beetle thrive—but

as it continues, it could cut the epidemic short.

Or maybe not. The genome work has shown that mountain pine beetles are as genetically variable as humans are. That genetic variability is a source of adaptability; so is beetle behavior. For whatever reason, beetles at the northern end of the Rocky Mountains in Canada seem better able to deal with cold temperatures than beetles in the United States. No one really knows yet how the species—or the forests themselves—will respond to a warmer future.

IN THE JEMEZ MOUNTAINS of northern New Mexico, a few miles west of Bandelier National

***All over the world drought-stressed forests are being tipped toward death by rising temperatures.***

Monument, Craig Allen stands on an outcrop of flat, craggy rocks and stares into Cochiti Canyon. The slanting autumn sun carves shadows on the slopes. It's a spectacular vista, except for one thing: Virtually every tree in sight is dead.

A forest ecologist with the U.S. Geological Survey, Allen has been based at Bandelier and taking in this view for nearly 30 years, and his heartbreak is palpable. Mountain pine beetles weren't a factor here—Bandelier is at the southern end of their range—but other species of bark beetle have killed many trees. So has a trio of huge wildfires, the last in 2011. In all, about two-thirds of the trees in Bandelier have died since 1996. Some forests vanished completely, killed by one fire and consumed by the next, leaving open meadows where thick stands of trees recently stood.

What happened in the Jemez Mountains, Allen says, is an extreme example of an emerging global phenomenon—what Diana Six calls tipping ecosystems. In New Mexico, beetles and

fires tipped a system that was already stressed by drought. And all over the world, as in New Mexico, according to studies done by Allen and other researchers, drought-stressed forests are being tipped toward death by a global amplifier: rising temperatures.

We tend to equate drought with a dearth of rainfall. But warmer air can also reduce a tree's water supply, by pulling even more moisture out of leaves and soil. The Jemez Mountains got hit by both: a severe lack of rain compounded by soaring temperatures. Allen calls this kind of historically unprecedented combination of drought and heat a global-change-type drought. It has caused forest die-offs in other parts of the world too, from southwest Australia to inner Asia and from the Amazon to the Mediterranean. The warmer future forecast by climate models suggests the American Southwest in particular is in for more of the same: Allen, Park Williams of Columbia University, and their colleagues project that by 2050 the stress on southwestern forests will routinely be worse than in the worst droughts of the past millennium.

For all the destruction wrought by pine beetles, they may be simply messengers. Around Bandelier these days the dead trees are falling pretty much every day. Cautionary road signs show one falling on a person. In much of the area, Allen says, the trees won't regrow; grasses and shrubs are replacing them. Driving back down into Los Alamos, he tries to conjure some optimism. Elk love the new open meadows, he points out.

"People always say things like, A thousand acres were lost," he says. "But they weren't actually lost. The land is still there, full of new life again. I personally lost friends in the fires—individual ancient trees I knew and loved. But these systems are in the process of adjusting. Nature goes on."

That's no doubt a healthy attitude, but it's not an easy one to sustain. In Montana, Six too has seen massive changes to landscapes she loves. At the turnoff to a forest road not far from Butte a sign says, "Keep Montana green." Six laughs mordantly. "Tell that to the beetles," she says. □





Trajan, who ruled from A.D. 98 until 117, when he fell ill and died, expanded the Roman Empire to its farthest boundaries. In this marble statue he wears armor typically used in triumphal parades.

NY CARLSBERG GLYPTOTEK, COPENHAGEN;  
PHOTOGRAPHED AT MUSEI CAPITOLINI, ROME

AT 126 FEET TALL,  
CUT FROM MARBLE,  
ADORNED WITH A  
SPIRAL FRIEZE  
INTRICATELY CARVED  
WITH 155 SCENES,  
**TRAJAN'S  
AMAZING  
COLUMN**  
IS A WAR DIARY  
THAT SOARS OVER  
ROME. ITS TALE:  
HOW THE EMPEROR  
VANQUISHED A  
FIERCE BUT  
NOBLE ENEMY.



Trajan's Column, with a statue of St. Peter installed by a Renaissance pope on top, towers over the ruins of Trajan's Forum, which once included two libraries and a grand civic space paid for by war spoils from Dacia. The massive modern monument at right commemorates Victor Emmanuel II, the first king of a united Italy.











*By Andrew Curry   Photographs by Kenneth Garrett*

**I**n back-to-back wars fought between A.D. 101 and 106, the emperor Trajan mustered tens of thousands of Roman troops, crossed the Danube River on two of the longest bridges the ancient world had ever seen, defeated a mighty barbarian empire on its mountainous home turf twice, then systematically wiped it from the face of Europe.



In a visual narrative that winds from the column's base to its top, Trajan and his soldiers triumph over the Dacians. In this scene from a plaster and marble-dust cast made between 1939 and 1943, Trajan (at far left) watches a battle, while two Roman auxiliaries present him with severed enemy heads.

Trajan's war on the Dacians, a civilization in what is now Romania, was the defining event of his 19-year rule. The loot he brought back was staggering. One contemporary chronicler boasted that the conquest yielded a half million pounds of gold and a million pounds of silver, not to mention a fertile new province.

The booty changed the landscape of Rome. To commemorate the victory, Trajan commissioned a forum that included a spacious plaza surrounded by colonnades, two libraries, a grand civic space known as the Basilica Ulpia, and possibly even a temple. The forum was "unique under the heavens," one early historian enthused, "begging description and never again to be imitated by mortal men."

Towering over it was a stone column 126 feet

high, crowned with a bronze statue of the conqueror. Spiraling around the column like a modern-day comic strip is a narrative of the Dacian campaigns: Thousands of intricately carved Romans and Dacians march, build, fight, sail, sneak, negotiate, plead, and perish in 155 scenes. Completed in 113, the column has stood for more than 1,900 years.

Today tourists crane their necks up at it as guides explain its history. The eroded carvings are hard to make out above the first few twists of the story. All around are ruins—empty pedestals, cracked flagstones, broken pillars, and shattered sculptures hint at the magnificence of Trajan's Forum, now fenced off and closed to the public, a testament to past imperial glory.

The column is one of the most distinctive monumental sculptures to have survived the fall of Rome. For centuries classicists have treated the carvings as a visual history of the wars, with Trajan as the hero and Decebalus, the Dacian king, as his worthy opponent. Archaeologists have scrutinized the scenes to learn about the uniforms, weapons, equipment, and tactics the Roman Army used.

And because Trajan left Dacia in ruins, the column and the remaining sculptures of defeated soldiers that once decorated the forum are treasured today by Romanians as clues to how their Dacian ancestors may have looked and dressed.

The column was deeply influential, the inspiration for later monuments in Rome and across the empire. Over the centuries, as the city's landmarks crumbled, the column continued to fascinate and awe. A Renaissance pope replaced the statue of Trajan with one of St. Peter, to sanctify the ancient artifact. Artists lowered themselves in baskets from the top to study it in detail. Later it was a favorite attraction for tourists: Goethe, the German poet, climbed the 185 internal steps in 1787 to "enjoy that incomparable view." Plaster casts of the column were made starting in the 1500s, and they have preserved details that acid rain and pollution have worn away.

Debate still simmers over the column's construction, meaning, and most of all, historical



accuracy. It sometimes seems as if there are as many interpretations as there are carved figures, and there are 2,662 of those.

FILIPPO COARELLI, a courtly Italian archaeologist and art historian in his late 70s, literally wrote the book on the subject. In his sun-flooded living room in Rome, he pulls his illustrated history of the column off a crowded bookshelf. “The column is an amazing work,” he says, leafing through black-and-white photos of the carvings, pausing to admire dramatic scenes. “The Dacian women torturing Roman soldiers? The weeping Dacians poisoning themselves to avoid capture? It’s like a TV series.”

Or, Coarelli says, like Trajan’s memoirs. When it was built, the column stood between the two libraries, which perhaps held the soldier-emperor’s account of the wars. The way Coarelli sees it, the carving resembles a scroll, the likely form of Trajan’s war diary. “The artist—and artists at this time didn’t have the freedom to do what they wanted—must have acted according to Trajan’s will,” he says.

Working under the supervision of a maestro, Coarelli says, sculptors followed a plan to create a skyscraping version of Trajan’s scroll on 17 drums of the finest Carrara marble.

The emperor is the story’s hero. He appears 58 times, depicted as a canny commander, accomplished statesman, and pious ruler. Here he is giving a speech to the troops; there he is thoughtfully conferring with his advisers; over

there, presiding over a sacrifice to the gods. “It’s Trajan’s attempt to be not only a man of the army,” Coarelli says, “but also a man of culture.”

Of course Coarelli’s speculating. Whatever form they took, Trajan’s memoirs are long gone. In fact clues gleaned from the column and excavations at Sarmizegetusa, the Dacian capital, suggest that the carvings say more about Roman preoccupations than about history.

Jon Coulston, an expert on Roman iconography, arms, and equipment at the University of St. Andrews in Scotland, studied the column up close for months from the scaffolding that surrounded it during restoration work in the 1980s and ’90s. He wrote his doctoral dissertation on the landmark and has remained obsessed—and pugnaciously contrarian—ever since. “People desperately want to compare it to news media and films,” he says. “They’re overinterpreting and always have. It’s all generic. You can’t believe a word of it.”

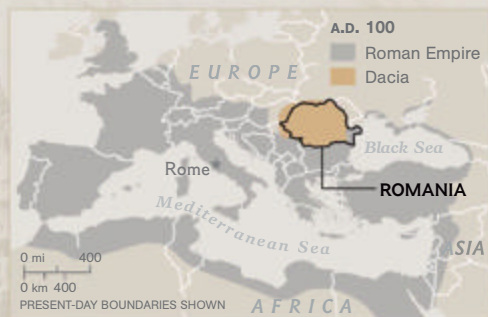
Coulston argues that no single mastermind was behind the carvings. Slight differences in style and obvious mistakes, such as windows that disrupt scenes and scenes of inconsistent heights, convinced him that sculptors created the column on the fly, relying on what they’d heard about the wars. “Instead of having what art historians love, which is a great master and creative mind,” he says, “the composition is being done by grunts at the stone face, not on a drawing board in the studio.”

The artwork, in his view, was more “inspired by” than “based on.” Take the column’s priorities. There’s not much fighting in its depiction of the two wars. Less than a quarter of the frieze shows battles or sieges, and Trajan himself is never shown in combat.



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*Andrew Curry wrote about the Roman frontier in the September 2012 issue. Kenneth Garrett is a frequent contributor.*



## Trajan's Dacian Wars

From their powerful realm north of the Danube River, the Dacians regularly raided the Roman Empire. In A.D. 101 Trajan fortified the border and invaded with tens of thousands of troops. Two years of war led to a negotiated peace, which the Dacians promptly broke. Trajan returned in 105 and crushed them.



In the first major battle Trajan defeated the Dacians (background) at Tapae. A storm indicated to the Romans (foreground) that the god Jupiter, with his thunderbolts, was on their side.







6.7 INCHES HIGH, FOURTH CENTURY B.C.



0.7-0.83 IN, FIRST CENTURY B.C.

## A Wealth of “Barbarian” Art

Dacians fashioned precious metals into jewelry, coins, and art, such as the gold-trimmed silver drinking vessel at left. These gold coins with Roman imagery and bracelets weighing up to two pounds each were looted from the ruins of Sarmizegetusa, the Dacian capital, and recovered in recent years.

Meanwhile legionaries—the highly trained backbone of Rome’s war machine—occupy themselves with building forts and bridges, clearing roads, even harvesting crops. The column portrays them as a force of order and civilization, not destruction and conquest. You’d think they were invincible too, since there’s not a single dead Roman soldier on the column.

THE COLUMN EMPHASIZES Rome’s vast empire. Trajan’s army includes African cavalymen with dreadlocks, Iberians slinging stones, Levantine archers wearing pointy helmets, and bare-chested Germans in pants, which would have appeared exotic to toga-clad Romans. They’re all fighting the Dacians, suggesting that anyone, no matter how wild their hair or crazy their fashion sense, could become a Roman. (Trajan was born to Roman parents in what is now Spain.)

Some scenes remain ambiguous and their

interpretations controversial. Are the besieged Dacians reaching for a cup to commit suicide by drinking poison rather than face humiliation at the hands of the conquering Romans? Or are they just thirsty? Are the Dacian nobles gathered around Trajan in scene after scene surrendering or negotiating?

And what about the shocking depiction of women torturing shirtless, bound captives with flaming torches? Italians see them as captive Romans suffering at the hands of barbarian women. Ernest Oberländer-Târnoveanu, the head of the National History Museum of Romania, begs to differ: “They’re definitely Dacian prisoners being tortured by the angry widows of slain Roman soldiers.” Like much about the column, what you see tends to depend on what you think of the Romans and the Dacians.

Among Roman politicians, “Dacian” was synonymous with double-dealing. The historian



3.9-4.7 IN (DIAMETER), SECOND CENTURY B.C.–  
FIRST CENTURY A.D.

Tacitus called them “a people which never can be trusted.” They were known for squeezing the equivalent of protection money out of the Roman Empire while sending warriors to raid its frontier towns. In 101 Trajan moved to punish the troublesome Dacians. After nearly two years of battle Decebalus, the Dacian king, negotiated a treaty with Trajan, then promptly broke it.

Rome had been betrayed one time too many. During the second invasion Trajan didn’t mess around. Just look at the scenes that show the looting of Sarmizegetusa or villages in flames.

“The campaigns were dreadful and violent,” says Roberto Meneghini, the Italian archaeologist in charge of excavating Trajan’s Forum. “Look at the Romans fighting with cutoff heads in their mouths. War is war. The Roman legions were known to be quite violent and fierce.”

Yet once the Dacians were vanquished, they became a favorite theme for Roman sculptors.

Trajan’s Forum had dozens of statues of handsome, bearded Dacian warriors, a proud marble army in the very heart of Rome.

The message seems intended for Romans, not the surviving Dacians, most of whom had been sold as slaves. “No Dacians were able to come and see the column,” Meneghini says. “It was for Roman citizens, to show the power of the imperial machinery, capable of conquering such a noble and fierce people.”

TRAJAN’S COLUMN may be propaganda, but archaeologists say there’s an element of truth to it. Excavations at Dacian sites, including Sarmizegetusa, continue to reveal traces of a civilization far more sophisticated than implied by “barbarian,” the dismissive term the Romans used.

The Dacians had no written language, so what we know about their culture is filtered through Roman sources. Ample evidence suggests that



This scene shows Roman soldiers loading plunder onto pack animals after defeating Decebalus, the Dacian king. Casts such as this one preserve details on Trajan's Column that pollution has eroded.

NATIONAL HISTORY MUSEUM OF ROMANIA











they were a regional power for centuries, raiding and exacting tribute from their neighbors. They were skilled metalworkers, mining and smelting iron and panning for gold to create magnificently ornamented jewelry and weaponry.

Sarmizegetusa was their political and spiritual capital. The ruined city lies high in the mountains of central Romania. In Trajan's day the thousand-mile journey from Rome would have taken a month at least. To get to the site today, visitors have to negotiate a potholed dirt road through the same forbidding valley that Trajan faced. Back then the passes were guarded by elaborate ridgetop fortifications; now only a few peasant huts keep watch.

The towering beech trees that have grown thick over Sarmizegetusa blot out the sun, casting a chill shade even on a warm day. A broad flagstone road leads from the thick, half-buried

walls of a fortress down to a wide, flat meadow.

This green expanse—a terrace carved out of the mountainside—was the religious heart of the Dacian world. Traces of buildings remain, a mix of original stones and concrete reproductions, the legacy of an aborted communist-era attempt to reconstruct the site. A triple ring of stone pillars outlines a once impressive temple that distantly echoes the round Dacian buildings on Trajan's Column. Next to it is a low, circular stone altar carved with a sunburst pattern, the sacred center of the Dacian universe.

FOR THE PAST SIX YEARS Gelu Florea, an archaeologist from Babeș-Bolyai University in Cluj-Napoca, has spent summers excavating the site. The exposed ruins, along with artifacts recovered from looters, reveal a thriving hub of manufacturing and religious ritual. Florea and



A partially reconstructed temple stands near a round altar in the sacred precinct of Sarmizegetusa, which was demolished after Rome's victory. Trajan colonized his newest province with Roman war veterans, a legacy reflected in the country's modern name, Romania.

his team have found evidence of Roman military know-how and Greek architectural and artistic influences. Using aerial imaging, archaeologists have identified more than 260 man-made terraces, which stretch for nearly three miles along the valley. The entire settlement covered more than 700 acres. "It's amazing to see how cosmopolitan they were up in the mountains," says Florea. "It's the biggest, most representative, most complex settlement in Dacia."

There is no sign that the Dacians grew food up here. There are no cultivated fields. Instead archaeologists have found the remains of dense clusters of workshops and houses, along with furnaces for refining iron ore, tons of iron hunks ready for working, and dozens of anvils. It seems the city was a center of metal production, supplying other Dacians with weapons and tools in exchange for gold and grain.

The site is lush and quiet. Not far from the altar rises a small spring that could have provided water for religious rituals. Flecks of natural mica make the dirt paths sparkle in the sun. The few tourists speak in hushed voices.

It's hard to imagine the ceremonies that took place here—and the terrible end. As Florea conjures the smoke and screams, looting and slaughter, suicides and panic depicted on Trajan's Column, there's a rumble of thunder. The sky is suddenly menacing, the air sticky and humid.

The destruction of Dacia's holiest temples and altars followed Sarmizegetusa's fall. "Everything was dismantled by the Romans," Florea says. "There wasn't a building remaining in the entire fortress. It was a show of power—we have the means, we have the power, we are the bosses."

The rest of Dacia was devastated too. Near the top of the column is a glimpse of the denouement: a village put to the torch, Dacians fleeing, a province empty of all but cows and goats.

The two wars must have killed tens of thousands. A contemporary claimed that Trajan took 500,000 prisoners, bringing some 10,000 to Rome to fight in the gladiatorial games that were staged for 123 days in celebration.

Dacia's proud ruler spared himself the humiliation of surrender. His end is carved on his archrival's column. Kneeling under an oak tree, he raises a long, curved knife to his own neck.

"Decebalus, when his capital and all his territory had been occupied and he was himself in danger of being captured, committed suicide; and his head was brought to Rome," the Roman historian Cassius Dio wrote a century later. "In this way Dacia became subject to the Romans." □

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# Argentine Identities

Story and Photographs by  
**MARCO VERNASCHI**

**A**rgentina is a promised land blessed with incredible beauty and potential. I wanted to create a project that would emphasize its diversity, foster conservation, and empower rural communities to reach their productive and social potential. To support this work, I created a foundation called Biophilia (*biophilia-foundation.org*), which means a love for life.

Since I moved here from Italy ten years ago, I've seen Argentina's economy become more and more focused on the large-scale cultivation of genetically modified soybeans. This is tragic, in terms of both culture and biodiversity. I felt the need to do something about this by working to create an alternative approach to a more sustainable future.

So on December 27, 2013, my wife, Juli, and I began a five-month journey across the country. We worked with rural farmers and small-scale food producers to select, conceive, and shape a specific set of projects in four different Argentine regions:

## **JUJUY PROVINCE**

The Suris, also known as Samilantes, are a cultural group within the Quechua community. This woman is Belén Cruz. Her feathered costume represents the nandu, or rhea, sacred bird of the Suris.





## **MISIONES PROVINCE**

The Jasy Pora Guaraní community lives in the Argentine Amazon near Brazil.

"I spent a beautiful time with this community," says Vernaschi. Their Spanish names reflect a colonial past. Here, Hugo Martínez poses with his coati.







the northwestern Altiplano, the northeastern Mesopotamia, the Gran Chaco, and Patagonia. During that research period we produced this series of photographs.

I was tired of pictures that depicted farmers—which all of these people are—as poor, as digging in the dirt. Because I wanted to portray them differently, I chose to focus on their cultures. That's why I asked the Suri girl and the two Diablos to dress in traditional ceremonial or carnival apparel for their portraits.

Ultimately, Biophilia's goal is to help these indigenous groups preserve their cultural heritage by developing their own local economies through native products, like potatoes, quinoa, and vicuña wool. Eventually we hope to help them develop brands, so that they can commercialize their products and participate in the fair trade market.

The trick is to connect each group's productive potential directly to the enhancement of the natural landscape. At the same time, it is crucial that we take into serious account cultural identity, which is so important to Argentina's diversity.

Working with these communities has been an enriching experience. If we keep our hearts open and respect every culture, there are lessons to be learned every day. □

#### JUJUY PROVINCE

Dario González and his son, Carlos, belong to a group called Los Diablos—part of the Quechua community. They believe the devil has the power to both curse and protect.









## NEUQUÉN PROVINCE

These photographs were made in Patagonia's Lake Nahuel Huapí area, home to an indigenous group of people called the Mapuche. "There are not many left," says Vernaschi. "Colonialism robbed them of their land a century ago. We want to help them reclaim it." Many of the Mapuche are hunters, including Salvador Quintriqueo (seated, top) and his son, Ricardo. The Mapuche also raise angora goats, which were brought to this region from Turkey. Wool is a major source of income in Patagonia, yet the non-native goats have disturbed the environment, says Vernaschi, so relying on them is ultimately unsustainable. Mapuche homes, like that of Marita Andreau (standing, right, with friend Rosa Andreau), have no electricity or running water.















## JUJUY PROVINCE

"This proud girl is Araceli del Rosario Suárez," Vernaschi says. "Most people think of gauchos—probably Argentina's best known cultural group—as men, but it is the women who uphold tradition."



## In the Loupe

With Bill Bonner, National Geographic Archivist



## Leaf Peeper

On a Maui hillside, leaves of the ‘ape’ape plant dwarf a man standing in their shade. “The human figure gives an accurate conception of the size of this strange, beautiful vegetation,” notes this photo’s caption in the February 1924 *Geographic*. “He stands in the same plane as the plants, which were growing on the slopes of the extinct volcano Haleakala, in a small gulch which had the hot, moist fragrance of a greenhouse.”

The editors back then must have really liked the image: Two versions (with the same man) appear in the issue, titled “The Hawaiian Islands: America’s Strongest Outpost of Defense—The Volcanic and Floral Wonderland of the World.” —Margaret G. Zackowitz



PHOTO: GILBERT H. GROSVENOR, NATIONAL GEOGRAPHIC CREATIVE

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**Tres Marias Cottontail** (*Sylvilagus graysoni*)

**Size:** Body length, 43.5 - 48 cm (17 - 19 inches); tail, 3.2 - 5 cm (1.2 - 2 inches) **Weight:** Unknown **Habitat:** Endemic to four islands off Central Mexico **Surviving number:** Unknown; populations declining



Photographed by Claudio Contreras Koob

# WILDLIFE AS CANON SEES IT

Fearless. Living literally "away from it all" on four islands, the Tres Marias cottontail has lost its fear of predators and humans. The unwary rabbit forages at night and stays under bushes and cacti during the day, but when startled out of cover it simply moves to an open spot, which allows people to approach and pick it up. It is also relatively easy pickings for falcons, raccoons

and non-native cats and rats. Authorities have established reserves for its protection, but habitat loss and the persistence of hunting remain frightening threats.

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**DAN BUETTNER** is the founder of Blue Zones, an organization that helps Americans live longer, healthier lives. His pioneering work on longevity led to a *National Geographic* cover story and two national bestsellers.

**OTHER BOOKS BY DAN BUETTNER:**



## THE Blue Zones Solution



Eating and Living Like  
the World's Healthiest People

Dan Buettner

New York Times Best-Selling Author



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